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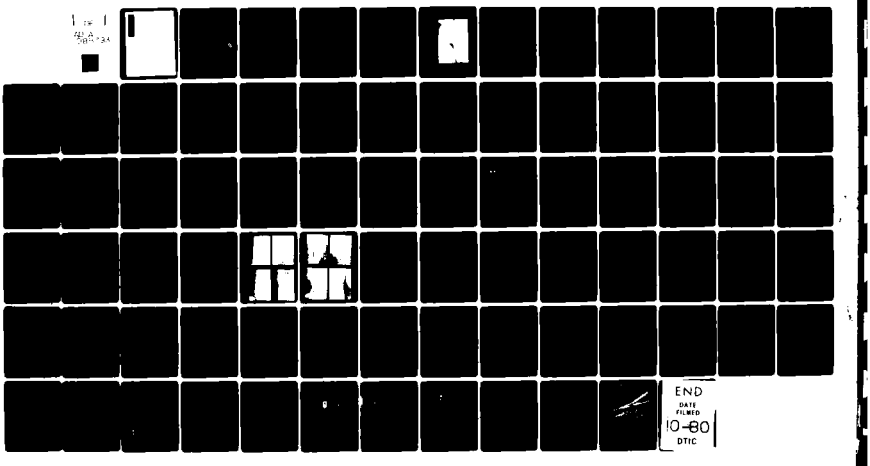

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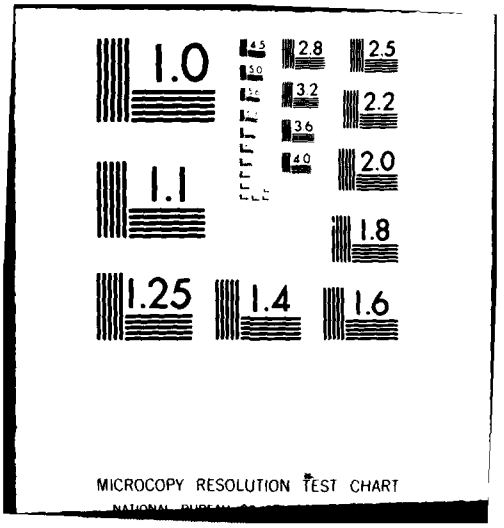
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SUSQUEHANNA RIVER BASIN
SHICKSHINNY CREEK, LUZERNE COUNTY, PENNSYLVANIA

National Dam Inspection Program

SHICKSHINNY LAKE DAM

NDS ID Number PA-572
DER ID Number 40-220

JOHN FTORKOWSKI

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

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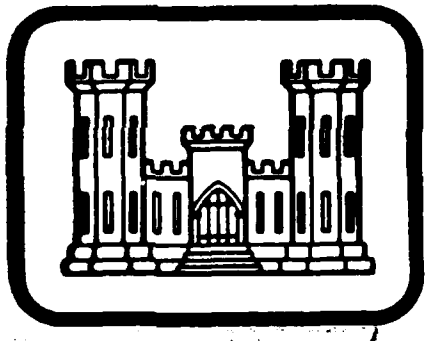

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Prepared By
L. ROBERT KIMBALL & ASSOCIATES
CONSULTING ENGINEERS & ARCHITECTS
EBENSBURG, PENNSYLVANIA
15931

FOR
DEPARTMENT OF THE ARMY
BALTIMORE DISTRICT CORPS OF ENGINEERS
BALTIMORE, MARYLAND
21203

JULY, 1980

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through frequent inspections can unsafe conditions be detected and only through continued care and maintenance can these conditions be prevented or corrected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the spillway design flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The spillway design flood provides a measure of relative spillway capacity and serves as an aid in detemining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

PHASE I REPORT
NATIONAL DAM INSPECTION REPORT

NAME OF DAM	Shickshinny Lake Dam
STATE LOCATED	Pennsylvania
COUNTY LOCATED	Luzerne
STREAM	Shickshinny Creek
DATE OF INSPECTION	April 10, 1980

ASSESSMENT

The assessment of Shickshinny Lake Dam is based upon visual observations made at the time of inspection, review of available records and data, hydraulic and hydrologic computations and past operational performance.

Shickshinny Lake Dam is a high hazard-intermediate size dam. The spillway design flood is the PMF (Probable Maximum Flood). In general, the dam and appurtenant structures appear to be in good condition.

Based on our hydraulic and hydrologic analysis it was determined that the spillway and reservoir are capable of controlling approximately 52% of the PMF. Based on criteria established by the Corps of Engineers, the spillway is termed inadequate.

No major deficiencies were observed during the inspection. Seepage was noted at the left abutment contact and did not appear to be excessive. Erosion was observed at the outlet structure for the spillway and drainline.

The following recommendations and remedial measures should be instituted immediately.

1. An evaluation should be made of the emergency spillway to determine if riprap protection is required on the embankment slope which serves as a berm between the embankment and the emergency spillway. This evaluation should be conducted by a registered professional engineer knowledgeable in dam design and construction. Remedial measures should be conducted as required by the investigation.

2. Seepage observed on the left abutment contact adjacent to and east of the outlet structure for the discharge line should be monitored on a regular basis and after periods of heavy precipitation. The monitoring program and monitor readings should be evaluated by a registered professional engineer experienced in dam design and construction.

3. Riprap should be placed at the outlet of the discharge pipe to minimize erosion of the channel banks and prevent future erosion in the area.

4. Operation of the drainline valve should continue on a regular basis. The regulating facilities should also be lubricated on a regular basis.

5. A warning system should be developed to warn downstream residents of large spillway discharges or imminent failure of the dam.

6. A safety inspection program should be implemented with inspections at regular intervals by qualified personnel.

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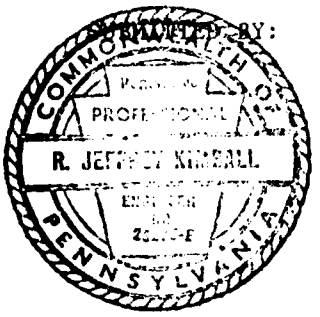


L. ROBERT KIMBALL & ASSOCIATES
CONSULTING ENGINEERS AND ARCHITECTS

Date

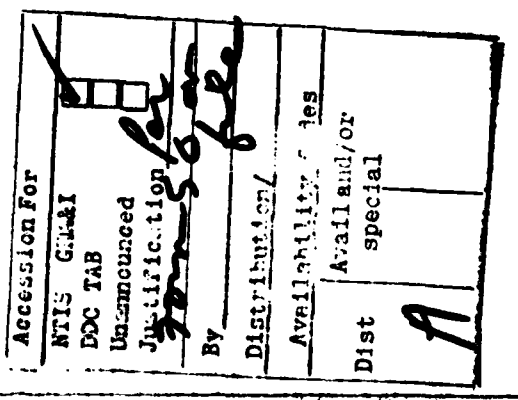
R. Jeffrey Kimball, P.E.

APPROVED BY:

15 August 80

Date

JAMES W. PECK
Colonel, Corps of Engineers
District Engineer



Overview of Shickshinny Lake Dam

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APPENDICES

PHASE I
NATIONAL DAM INSPECTION PROGRAM
SHICKSHINNY LAKE DAM
NDI. I.D. NO. PA 572
DER I.D. NO. 40-220

SECTION 1
PROJECT INFORMATION

1.1 General.

a. Authority. The National Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of inspection of dams throughout the United States.

b. Purpose. The purpose of the inspection is to determine if the dam constitutes a hazard to human life or property.

1.2 Description of Project.

a. Dam and Appurtenances. Shickshinny Lake Dam is an earthfill dam, 365 feet long and 33 feet high. The crest width of the dam is 17 feet. The upstream slope is 3H:1V and the downstream slope is 2.5H:1V. Both the upstream and downstream slopes are grass covered. Some riprap exists on the upstream slope. A roadway exists across the top of the dam and crosses the approach to the emergency spillway.

The normal pool for the reservoir is maintained at the principal spillway crest elevation. The principal spillway consists of a reinforced concrete riser and a 30" reinforced concrete pipe which passes under the dam. The outlet pipe, is bedded in a reinforced concrete cradle. Four reinforced concrete anti-seep collars are spaced 22 feet apart under the impervious core of the dam. The collars were designed to be 9 feet high, 10 feet wide, 8 inches thick and were to extend 2.5 feet above the top of the pipe. The outlet pipe is provided with a headwall and stilling basin at the downstream end. The riser unit orifice on either end of the intake structure has dimensions approximately equal to 1.5' by 6.0'. The walls are reinforced concrete 1 foot thick except at the bottom where they were constructed to a thickness of 1.25 feet. The top of the riser unit is provided with an anti-vortex device. A gate valve is provided on an inlet pipe just inside the riser unit. This valve operates from the top of the anti-vortex structure over the riser unit.

The embankment consists of two zones and a foundation cut off trench. The core of the dam is constructed of class "A"

fill, selected impervious material centrally located within the dam. The upstream slope is constructed of a class "A" impervious material and the downstream slope was to be constructed of class "B" fill. The cutoff trench is excavated to a variable depth as determined in the field, with a minimum depth of 8 feet or keyed into rock with a bottom width of 10 feet. The dam crest is designed with a width of 18 feet, with a downstream slope of 2H:1V and an upstream slope of 2.5H:1V. At three feet below normal pool (upstream slope) is a 10 foot wide berm. The upstream slope of the dam, is provided with a zone of riprap 24 inches thick placed upon a 12 inch thick zone of subbase to prevent erosion. The dam is constructed with a downstream toe drain. The drain consists of a 6 inch perforated asbestos cement pipe laid in a trench just inside the toe of the dam. The trench is backfilled with broken stone, and extends the full length of the dam, forming a portion of the downstream toe of the dam.

An emergency spillway exists at the right abutment of the dam. The emergency spillway is cut into natural ground and has a bottom width of approximately 65 feet. The section is trapezoidal in shape with side slopes ranging from 2H:1V to 3H:1V. Flow through the emergency spillway discharges beyond the toe of dam into Shickshinny Creek.

b. Location. The dam is located on Shickshinny Creek, approximately 4.5 miles northwest of Shickshinny, Luzerne County, Pennsylvania. Shickshinny Lake Dam can be located on the Shickshinny, U.S.G.S. 7.5 minute quadrangle.

c. Size Classification. Shickshinny Lake Dam is an intermediate size dam (33 feet high, 3575 ac-ft).

d. Hazard Classification. Shickshinny Lake Dam is a high hazard dam. Downstream conditions indicate that loss of more than a few lives is probable should the structure fail. Three homes (12 people) are located approximately 2 miles downstream of Shickshinny Lake Dam on Shickshinny Creek. The Borough of Shickshinny is located approximately 4.5 miles downstream.

e. Ownership. Shickshinny Lake Dam is owned by Mr. John T. Ftorkowski. Correspondence should be addressed to:

Mr. John T. Ftorkowski
Lot No. 162
Shickshinny Lake, Pennsylvania 18655
(717) 256-3967

f. Purpose of Dam. Shickshinny Lake Dam is used for recreation.

g. Design and Construction History. Construction of Shickshinny Lake Dam (formerly Lake Pyros) began in 1964. Based on information located in the PennDER files, it appears as though a registered architect from Wilkes-Barre, Pennsylvania, Mr. Edward T. Wassell of the firm Wassell and Pyros guided efforts to obtain a permit and was involved in the engineering efforts associated with the design and construction of Shickshinny Lake Dam.

Design drawings located in the PennDER files contain a title block on which appears the name of a registered professional engineer from Wilkes-Barre, Pennsylvania. The engineers name is Mr. Bernard Gallagher. Telephone contacts with Mr. Gallagher revealed that he was initially involved in the project but had nothing to do with the actual design or construction of the dam. The actual design engineer is unknown. The dam was constructed by a contractor from Ligonier, Pennsylvania, A.H. Sweeney.

In March, 1964, the corporate ownership of the dam was changed from the Lake Pyros Development Corporation to the Shickshinny Lake Development Corporation. The request for change of ownership was made by Mr. Sherman D. Hoover, President of the Shickshinny Lake Corporation.

Correspondence in the PennDER files contains various information relative to inspection during construction of the dam by representatives of the Division of Dams and Encroachments. Reference is also made to field density tests conducted at the site during the inspection. Reports from the owner relative to the progress of the construction also appear in the files. The correspondence suggest that monthly reports were submitted by the owner, Sherman D. Hoover. Construction of the dam was completed around April, 1965. Permission was granted to the owner to commence filling the impoundment with water at about this time.

At some date prior to February, 1969 the ownership of the dam again changed. The dam was purchased by the present owner, John Ftorkowski.

h. Normal Operating Procedures. The reservoir water level is maintained at the principal spillway crest elevation, 938.0. Normal discharges at the dam are through the principal spillway structure. Flow is discharged through a 30" reinforced concrete pipe which outlets beyond the toe of the dam. This pipe also acts as the reservoir drain and the pipe extends beyond the intake structure located on the upstream slope of the

dam. Excessive inflow to the reservoir is discharged through the emergency spillway structure located at the right abutment of the dam. The outlet for the emergency spillway channel is located beyond the toe of the dam.

1.3 Pertinent Data.

a. Drainage Area.

	0.36 square miles (indirect)
	5.59 square miles (direct)
	5.95 square miles (combined)

b. Discharge at Dam Site (cfs).

Maximum known flood at dam site	Unknown
Drainline capacity at normal pool	Unknown
Principal spillway capacity at top of dam	128
Emergency spillway capacity at top of dam	3335

c. Elevation (U.S.G.S. Datum) (feet). - Based on principal spillway crest elevation 938.0 from DER files.

Top of dam - low point	947.9
Top of dam - design height	Unknown
Maximum pool - design surcharge	Unknown
Full flood control pool	Unknown
Normal pool	938.0
Principal spillway crest	938.0
Emergency spillway crest	941.8
Upstream portal - 30" drainline	Unknown
Downstream portal - 30" drainline	915.0
Maximum tailwater	Unknown
Toe of dam	915.0

d. Reservoir (feet).

Length of maximum pool	8000 feet
Length of normal pool	7500 feet

e. Storage (acre-feet).

Normal pool	2450
Top of dam	3575

f. Reservoir Surface (acres).

Top of dam	200
Normal pool	117
Spillway crest	117

g. Dam.

Type	Earth embankment
Length	365 feet
Height	33 feet
Top width (field measurement)	17 feet
Top width (design)	18 feet
Side slopes (field measurement)	
- upstream	3H:1V
- downstream	2.5H:1V
Side slopes (design)	
- upstream	2.5H:1V
- downstream	2H:1V
Zoning	Yes
Impervious core	Clay core
Cutoff	Clay cutoff trench
Grout curtain	None

h. Reservoir Drain (principal spillway).

Type	18" RCP intake with 30" RCP outlet
Length	Unknown
Closure	Gate valve on upstream end
Access	Valve on intake structure
Regulating facilities	Valve on intake structure
Orifice in riser	Two 1.5 feet by 6.0 feet openings

i. Spillway (emergency).

Type	Open cut (trapezoidal)
Length	65 feet
Crest elevation	941.8
Upstream channel	Unrestricted approach channel
Downstream channel	Unrestricted discharge to Shickshinny Creek

SECTION 2
ENGINEERING DATA

2.1 Design. The owner did not provide any design or construction data on the dam. The Commonwealth of Pennsylvania, Department of Environmental Resources supplied some back-up data pertaining to general statistics of the dam, several design drawings, correspondence, permits and photographs for this structure. All this information was reviewed to complete this report.

2.2 Construction. Only minimal information exists on the construction of the dam.

2.3 Operation. No operating records are maintained.

2.4 Evaluation.

a. Availability. Engineering data was provided by PennDER, Bureau of Dams and Waterways Management and through interviews with a past and current owner of the dam. The owner's son, Jerry Ftorkoski, accompanied the inspection team during the inspection and was interviewed to obtain data on operation and maintenance of the dam.

b. Adequacy. Detailed analysis cannot be made because of the lack of detailed design information. This Phase I Report is based on available data, visual inspection, hydrologic and hydraulic analysis. Sufficient information exists to complete a Phase I Report.

SECTION 3
VISUAL INSPECTION

3.1 Findings.

a. General. The onsite inspection of Shickshinny Lake Dam was conducted by personnel of L. Robert Kimball and Associates on April 10, 1980. The inspection consisted of:

1. Visual inspection of the retaining structure, abutments and toe.
2. Examination of the spillway facilities, exposed portion of any outlet works and other appurtenant works.
3. Observations affecting the runoff potential of the drainage basin.
4. Evaluation of the downstream area hazard potential.

b. Dam. The dam appeared to be in good condition. From a brief survey conducted during the inspection, it was noted that a low area exists on the embankment approximately 130 feet from the left abutment. This location corresponds to the approximate location of the principal spillway structure and the discharge structure at the toe of the dam. The upstream slope is 3H:1V and the downstream slope is 2.5H:1V. Both the upstream and downstream slopes appear to be in good condition. The slopes are grass covered. A portion of the upstream slope is protected with riprap to a distance of several feet above the normal pool elevation. A bituminous surface roadway runs along the crest of the dam. Two (2) pine trees are growing on the upstream crest and should be removed.

Some seepage was noted during the inspection on the left abutment contact just east of the discharge structure. Seepage in this area was measured to be approximately 1 gallon per minute.

c. Appurtenant Structures. The principal spillway intake structure is located on the upstream slope of the embankment. The structure appeared to be in good condition. The regulating facilities for the drainline are located on the top of the intake structure. The valve controlling the drainline was not operated during the inspection but it was reported by the owner's son, Mr. Jerry Ftorkowski, that the valve is operated at least yearly. A discharge structure exists at the toe of the dam and contains the outlet for the 30" reinforced concrete drainline. The structure appeared to be in good condition although discharges from the drainline, which also serves as the discharge pipe for the principal spillway, was causing some erosion beyond the toe of the dam in the natural stream channel.

The emergency spillway for the dam is located at the right abutment and consists of an open cut trapezoidal channel. The base of the channel for its entire length was saturated with groundwater seepage from the right embankment slope. The emergency spillway is grass covered for its entire length except for a bituminous surface roadway which crosses the spillway approach and embankment crest.

The left embankment slope of the emergency spillway acts as a berm between emergency spillway discharges and the right abutment of the dam. Large discharges through the emergency spillway could potentially enable the berm, embankment and toe of the dam. The need for slope protection should be evaluated.

d. Reservoir Area. The watershed area is covered mostly with moderate to steep hills and woodlands. The reservoir slopes are moderate and do not appear to be susceptible to landslides which would affect the storage volume of the reservoir or overtopping of the dam by displacing water.

e. Downstream Channel. Shickshinny Creek provides the downstream channel for the Shickshinny Lake Dam. Several homes (12 people) are located along the stream approximately 2 miles downstream below the dam.

3.2 Evaluation. In general, the dam and appurtenant structures appear to be in good conditon.

SECTION 4
OPERATIONAL PROCEDURES

4.1 Procedures. The reservoir is maintained at the spillway crest elevation 938.0. The reservoir drain is operated at least yearly. Excess inflow to the reservoir discharges through the principal spillway. During periods of flooding the emergency spillway discharges the peak flows. The slopes of the dam are grass covered and appeared to be well maintained.

4.2 Maintenance of the Dam. No planned maintenance schedule exists. Maintenance of the dam is performed by the owner's son on an unscheduled basis. It was reported by the owner's son, that the valve and the regulating facilities are lubricated at least yearly. Maintenance of the dam is considered good.

4.3 Maintenance of Operating Facilities. The maintenance of the spillway and the outlet works is considered good.

4.4 Warning System in Effect. There is no warning system in effect to warn downstream residents of large spillway discharges or imminent failure of the dam.

4.5 Evaluation. Maintenance of the dam and operating facilities are considered good. There is no system in effect to warn downstream residents of large spillway discharges or imminent failure of the dam.

SECTION 5
HYDRAULICS AND HYDROLOGY

5.1 Evaluation of Features.

a. Design Data. No calculations or design data pertaining to the hydrology or hydraulics could be located.

b. Experience Data. No rainfall, runoff or reservoir level data could be located. The spillway reportedly has functioned adequately in the past.

The emergency spillway experienced some damage during the flooding associated with hurricane Agnes in 1972. The limits and extent of the damage are unknown.

c. Visual Observations. The spillway appeared to be in good condition. The exposed portion of the drainline and discharge structure appeared to be in good condition. The regulating facilities located on the intake structure appear to be in good condition, but were not operated during the inspection.

d. Overtopping Potential. Overtopping potential was investigated through the development of the probable maximum flood (PMF) for the watershed and the subsequent routing of the PMF and fractions of the PMF through the reservoir and spillway.

The Corps of Engineers, Baltimore District, has directed that the HEC-1 Dam Safety Version systemized computer program be utilized. The program was prepared by the Hydrologic Engineering Center (HEC), U.S. Army Corps of Engineers, Davis, California, July, 1978. The major methodologies or key input data for this program are discussed briefly in Appendix D.

5.2 Evaluation Assumptions. To enable us to complete the hydraulic and hydrologic analysis for this structure, it was necessary to make the following assumptions.

1. The pool elevation in the reservoir prior to the storm is at the emergency spillway crest elevation 941.8.

2. The top of dam was considered the low spot at elevation 947.9.

3. In the analysis of Shickshinny Lake Dam it was assumed that the upstream dam (Hidden Lake) failed.

4. Flow through the principal spillway was considered.

5.3 Summary of Overtopping Analysis. Complete summary sheets for the computer output are presented in Appendix D.

Peak inflow (PMF)	9178 cfs
Combined spillway capacity	3463 cfs

a. Spillway Adequacy Rating. The Spillway Design Flood is based on the hazard and size classification of the dam. The recommended spillway design flood (SDF) for an intermediate size dam is the PMF. Based on the following definition provided by the Corps of Engineers, the spillway is rated as inadequate as a result of our hydrologic analysis.

> Inadequate - High hazard classification dams not capable of passing the SDF.

The spillway and reservoir are capable of controlling approximately 52% of the PMF without overtopping the non-overflow sections.

5.4 Summary of Dam Breach Analysis. As the subject dam can satisfactorily pass 50% of the PMF (based on our analysis) is was not necessary to perform a dam breach analysis and downstream routing of the flood wave.

SECTION 6
STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability.

a. Visual Observations. Seepage was noted on the left abutment contact just east of the discharge structure on the downstream slope of the dam. Seepage in this area was measured to be approximately 1 gallon per minute. Discharges from the outlet structure at the toe of the dam appeared to be eroding the natural stream channel directly adjacent to the downstream toe. Riprap should be placed in this area to protect the discharge channel and to stop the erosion of the channel embankment adjacent to the toe area.

b. Design and Construction Data. No detailed design or construction data are available. Several drawings were made available by the PennDER. No stability analysis is known to have been conducted for this dam.

c. Operating Records. No operating records are maintained.

d. Post Construction Changes. The emergency spillway reportedly experienced some damage due to the heavy rains associated with hurricane Agnes in 1972. The present owner, Mr. John Ftorkowski, retained the services of the United States Department of Agriculture, Soil Conservation Service, Dallas, Pennsylvania, to repair the damage associated with the storm. It appears that though damage was confined to the emergency spillway area and that the damage was due to erosion in the emergency spillway area. No visible effects remain or were noted during our recent inspection. No data is available on the repair work.

e. Seismic Stability. The dam is located in seismic zone 1. No seismic stability analyses has been performed. Shickshinny Lake Dam appears to be stable. Normally, it can be considered that if a dam in this zone is stable under static loading conditions, it can be assumed safe for any expected earthquake loading.

SECTION 7
ASSESSMENT AND RECOMMENDATIONS/REMEDIAL MEASURES

7.1 Dam Assessment.

a. Safety. The dam appears to be in good condition and adequately maintained. No erosion was noted on the dam crest or on the upstream and downstream slopes. Seepage was noted at the left abutment contact adjacent to and east of the discharge structure near the toe of the dam. Seepage in this area was measured to be approximately 1 gallon per minute. The base of the emergency spillway is saturated and this condition is due to groundwater seepage from the right embankment section of the emergency spillway. This seepage appears to have no visible effects on the stability of the spillway section or the dam embankment. The visual observations, review of available data, hydraulic and hydrologic calculations, and past operational performance indicate that the Shickshinny Lake Dam's spillway is inadequate. The spillway is capable of controlling 52% of the PMF without overtopping the embankment. No structural stability analysis have been performed for this structure.

b. Adequacy of Information. Sufficient information is available to complete a Phase I Report.

c. Urgency. The recommendations suggested below should be implemented immediately.

d. Necessity for Further Investigation. In order to accomplish some of the recommendations/remedial measures outlined below, further investigations will be required.

7.2 Recommendations/Remedial Measures.

1. An evaluation should be made of the emergency spillway to determine if riprap protection is required on the embankment slope which serves as a berm between the embankment and the emergency spillway. This evaluation should be conducted by a registered professional engineer knowledgeable in dam design and construction. Remedial measures should be conducted as required by the investigation.

2. Seepage observed on the left abutment contact adjacent to and east of the outlet structure for the discharge line should be monitored on a regular basis and after periods of heavy precipitation. The monitoring program and monitor readings should be evaluated by a registered professional engineer experienced in dam design and construction.

3. Riprap should be placed at the outlet of the discharge pipe to minimize erosion of the channel banks and prevent future erosion in the area.

4. Operation of the drainline valve should continue on a regular basis. The regulating facilities should also be lubricated on a regular basis.

5. A warning system should be developed to warn downstream residents of large spillway discharges or imminent failure of the dam.

6. A safety inspection program should be implemented with inspections at regular intervals by qualified personnel.

APPENDIX A
CHECKLIST, VISUAL INSPECTION, PHASE I

CHECK LIST
VISUAL INSPECTION
PHASE I

NAME OF DAM Shickshinny Lake Dam COUNTY Luzerne STATE Pennsylvania ID# 572

TYPE OF DAM Earthfill HAZARD CATEGORY High

DATE(s) INSPECTION April 10, 1980 WEATHER Overcast and cool TEMPERATURE 50°

POOL ELEVATION AT TIME OF INSPECTION 938.0 M.S.L. TAILWATER AT TIME OF INSPECTION None M.S.L.

INSPECTION PERSONNEL:

R. Jeffrey Kimball, P.E. - L. Robert Kimball and Associates

James T. Hockensmith - L. Robert Kimball and Associates

O.T. McConnell - L. Robert Kimball and Associates

Mr. Jerry Ftorkowski - Caretaker

James T. Hockensmith
RECORDER

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	None noted.	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None noted.	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	None noted.	
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	Horizontal alignment appears to be good. Low spot on embankment crest approximately 130 feet from left abutment.	
RIPRAP FAILURES	Additional riprap needs to be placed at the discharge end of the principal spillway discharge pipe to stop erosion of the channel embankment and to prevent future erosion in the area.	

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
VEGETATION	Upstream and downstream slopes grass covered. Emergency spillway grass covered.	
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	No erosion protection at junction of dam and emergency spillway berm.	
ANY NOTICEABLE SEEPAGE	One seepage area noted at the left abutment contact approximately 40 feet east of the discharge structure. Seepage measured to be approximately 1 gallon per minute.	
STAFF GAUGE AND RECORDER	None.	
DRAINS	None visible.	

CONCRETE/MASONRY DAMS - Not applicable

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
ANY NOTICEABLE SEEPAGE		
STRUCTURE TO ABUTMENT/EMBANKMENT JUNCTIONS		
DRAINS		
WATER PASSAGES		
FOUNDATION		

CONCRETE/MASONRY DAMS - Not applicable

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS CONCRETE SURFACES		
STRUCTURAL CRACKING		
VERTICAL AND HORIZONTAL ALIGNMENT		
MONOLITH JOINTS		
CONSTRUCTION JOINTS		
STAFF GAUGE OR RECORDER		

OUTLET WORKS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	None noted.	
INTAKE STRUCTURE	Appears to be good.	
OUTLET STRUCTURE	Appears to be in good condition.	
OUTLET CHANNEL	Shickshinny Creek.	
EMERGENCY GATE	Located on intake structure on upstream slope of dam.	

UNGATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	Unobserved.	
APPROACH CHANNEL	Lake.	
DISCHARGE CHANNEL	30" reinforced concrete pipe.	
BRIDGE AND PIERS	None.	

GATED SPILLWAY - Not applicable

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE SILL		
APPROACH CHANNEL		
DISCHARGE CHANNEL		
BRIDGE AND PIERS		
GATES AND OPERATION EQUIPMENT		

DOWNSTREAM CHANNEL

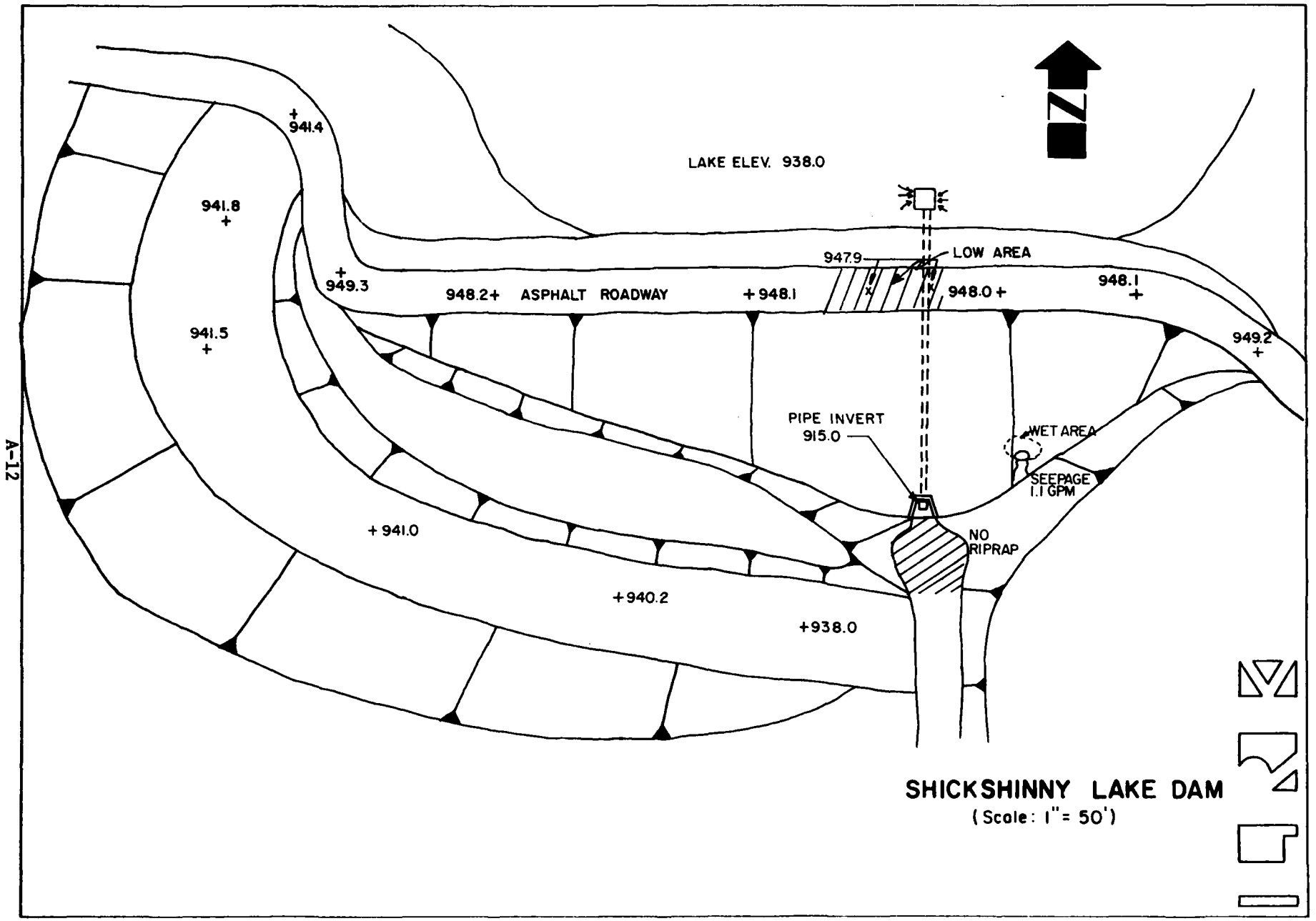
VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	Downstream channel for Shickshinny Lake Dam is provided by Shickshinny Creek.	
SLOPES	Moderate to steep but appear to be stable.	
APPROXIMATE NO. OF HOMES AND POPULATION	3 homes located approximately 2 miles downstream of Shickshinny Lake Dam. Approximately 12 people.	

RESERVOIR

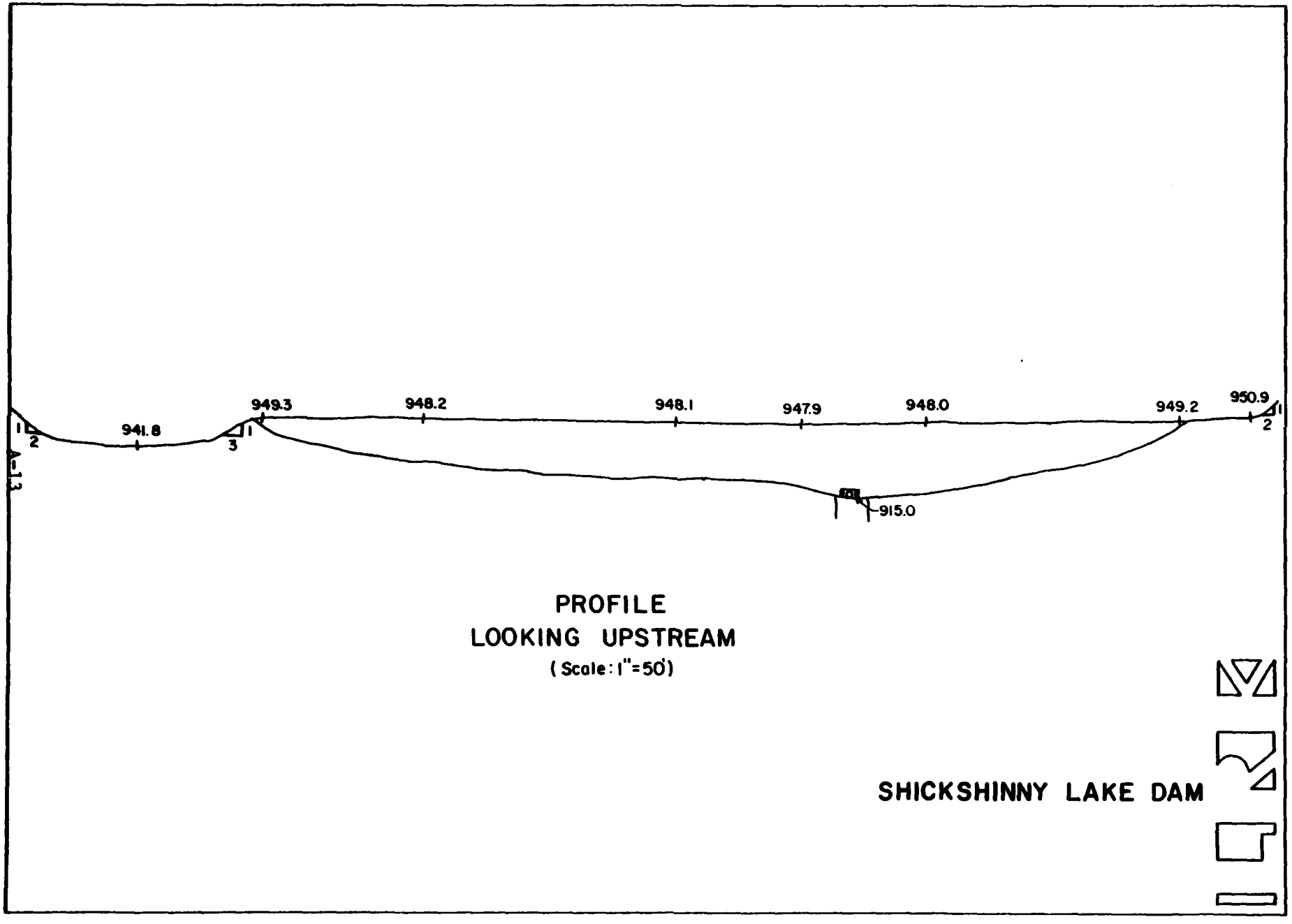
VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	Moderate.	
SEDIMENTATION	Unknown.	

INSTRUMENTATION

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	None.	
OBSERVATION WELLS	None.	
WEIRS	None.	
PIEZOMETERS	None.	
OTHER	None.	


N
LAKE ELEV. 938.0
941.4
941.8
949.3
948.2+ ASPHALT ROADWAY
+948.1
947.9
LOW AREA
948.0+
948.1
941.5
949.2
PIPE INVERT
915.0
WET AREA
SEEPAGE
1.1 GPM
+941.0
NO
RIPRAP
+940.2
+938.0
SHICKSHINNY LAKE DAM
(Scale: 1" = 50')

A-12



PROFILE
LOOKING UPSTREAM
(Scale: 1"=50')

SHICKSHINNY LAKE DAM

APPENDIX B
CHECKLIST, ENGINEERING DATA, DESIGN, CONSTRUCTION, OPERATION, PHASE I

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE I

NAME OF DAM Shickshinny Lake Dam

ID# 572

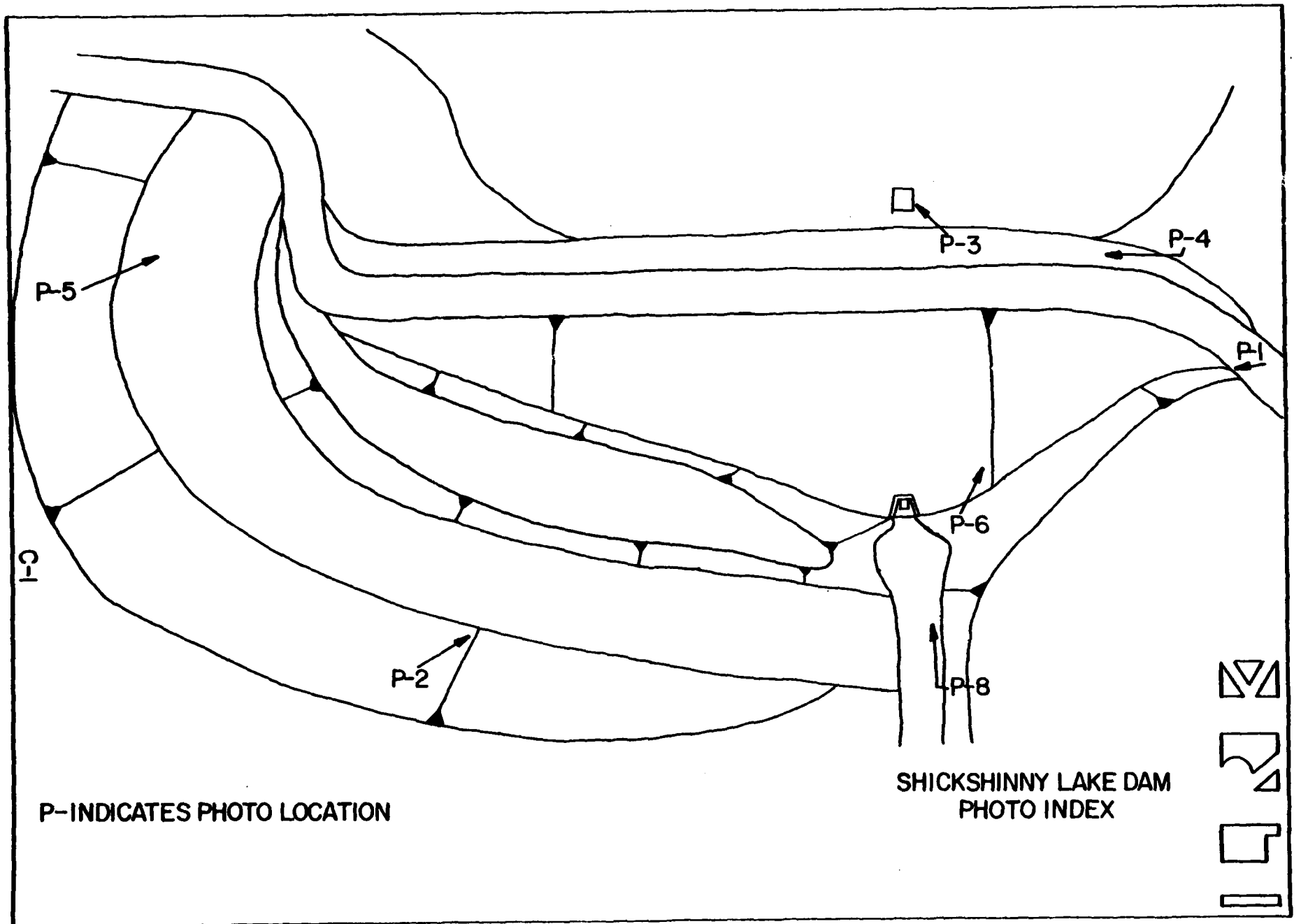
ITEM	REMARKS
AS-BUILT DRAWINGS	None.
REGIONAL VICINITY MAP	U.S.G.S. quadrangle.
CONSTRUCTION HISTORY	Very sketchy, some information available in DER files.
TYPICAL SECTIONS OF DAM	DER files.
OUTLETS - PLAN - DETAILS - CONSTRAINTS - DISCHARGE RATINGS RAINFALL/RESERVOIR RECORDS	DER files. DER files. None. None. None.

ITEM	REMARKS
DESIGN REPORTS	None. Specifications available in DER files.
GEOLOGY REPORTS	None.
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	Mimimal information available in DER files relative to potential inflow at the site.
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	Unknown.
POST-CONSTRUCTION SURVEYS OF DAM	Unknown.
BORROW SOURCES	Unknown.

ITEM	REMARKS
MONITORING SYSTEMS	None.
MODIFICATIONS	Emergency spillway repaired after 1972 flood associated with hurricane Agnes.
HIGH POOL RECORDS	None.
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	Possible information available through the United States Department of Agriculture, Soil Conservation Service, Federal Building Dallas, Pennsylvania 18612. The Soil Conservation Service, Dallas, Pennsylvania was retained to rectify damage which occurred in the emergency spillway due to floods associated with hurricane Agnes.
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	Unknown.
MAINTENANCE OPERATION RECORDS	None.

ITEM	REMARKS
SPILLWAY PLAN SECTIONS DETAILS	Drawings available in DER files.
OPERATING EQUIPMENT PLANS & DETAILS	None.

APPENDIX C
PHOTOGRAPHS


P-3
P-4
P-5
P-1
P-6
C-1
P-2
P-8
P-INDICATES PHOTO LOCATION
SHICKSHINNY LAKE DAM
PHOTO INDEX

SHICKSHINNY LAKE DAM
PA 572

Photo Descriptions

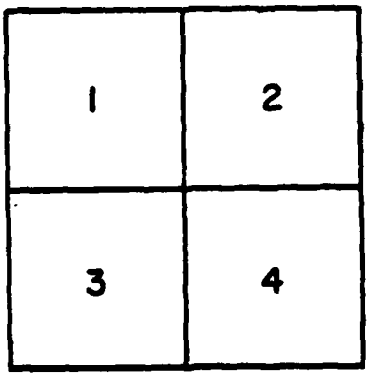
Sheet 1. Front

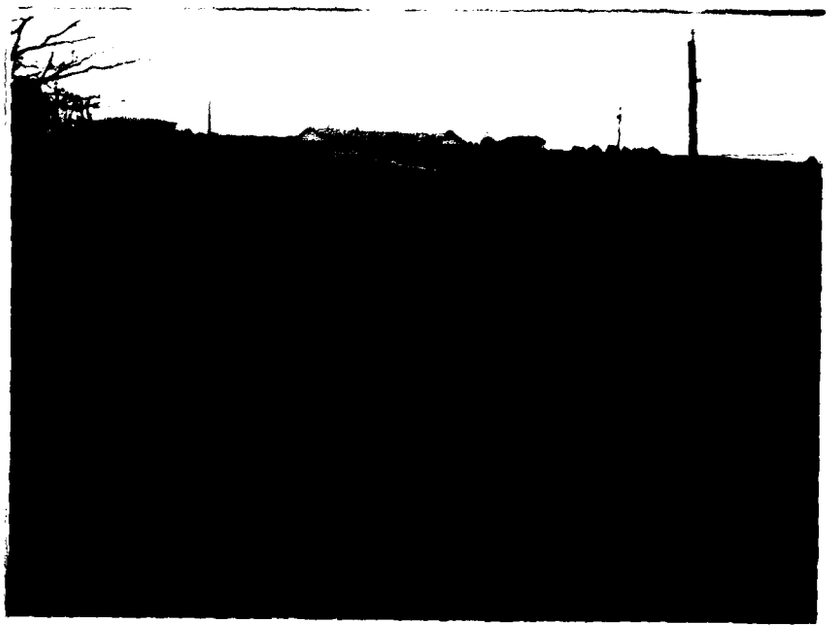
(1) Upper left - View of downstream slope and right abutment.
(2) Upper right - View of downstream slope. Note discharge end of emergency spillway in foreground.
(3) Lower left - Intake structure for the principal spillway. Note the valve control on structure
(4) Lower right - View of upstream slope, crest, emergency spillway approach and right abutment.

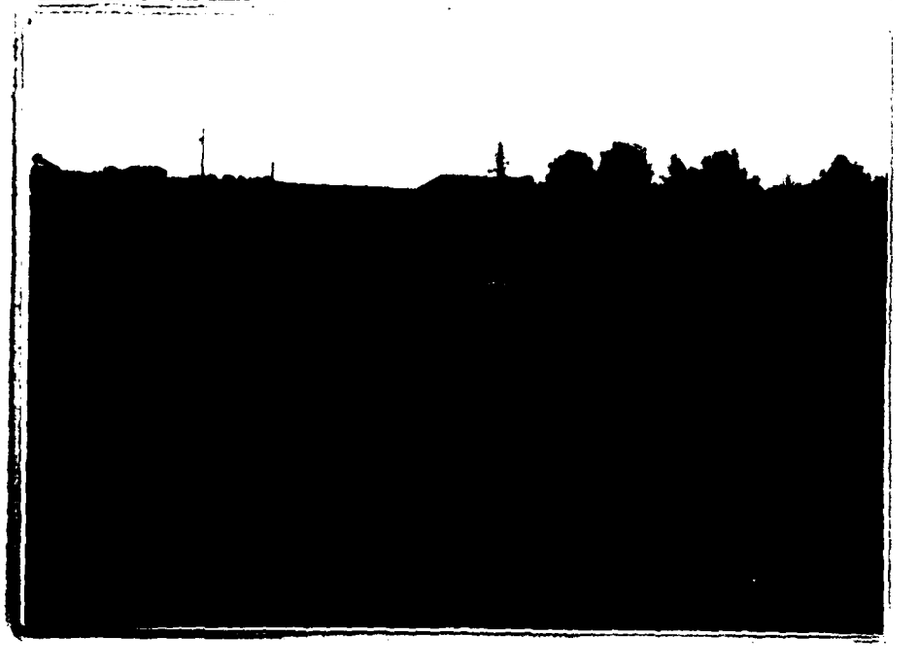
Sheet 1. Back

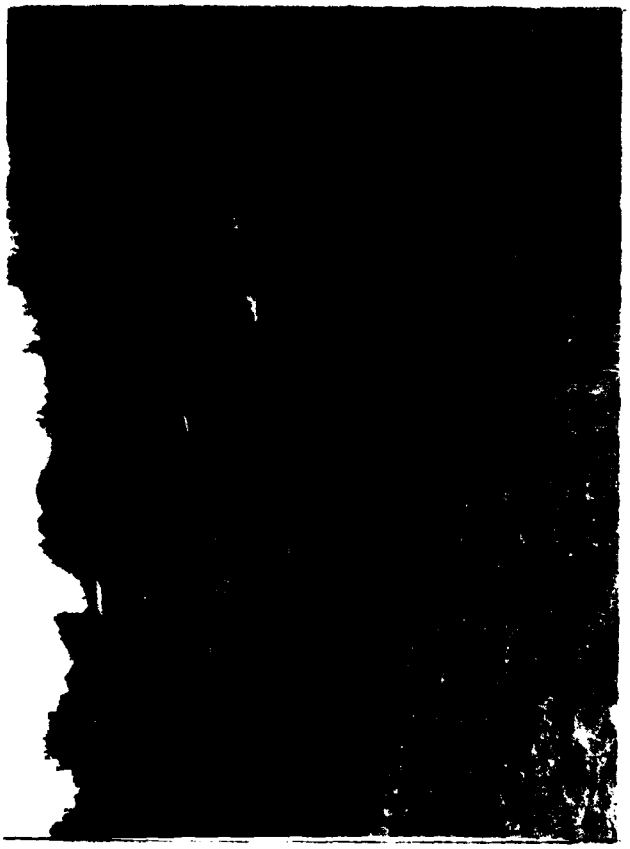
(5) Upper left - View of emergency spillway approach.
(6) Upper right - Seepage at the right abutment contact.
(7) Lower left - Downstream exposure.
(8) Lower right - Discharge structure for principal spillway and drainline.

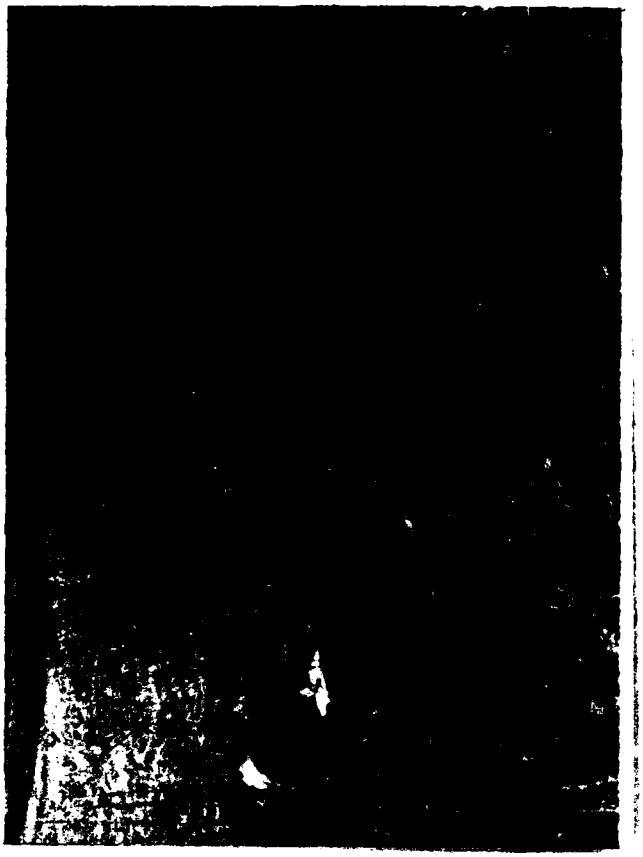
TOP OF PAGE

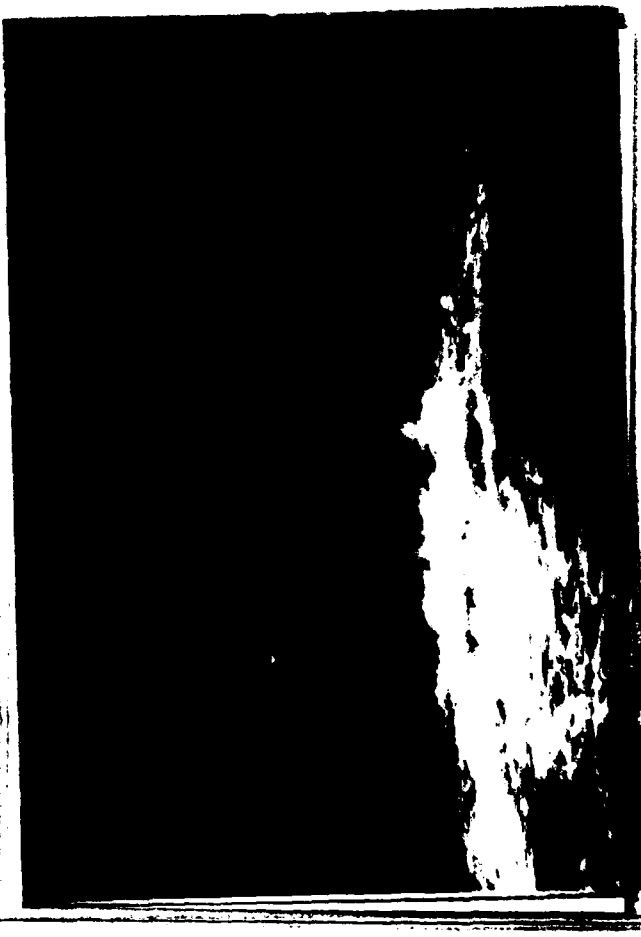












APPENDIX D
HYDROLOGY AND HYDRAULICS

APPENDIX D
HYDROLOGY AND HYDRAULICS

Methodology. The dam overtopping and breach analyses were accomplished using the systemized computer program HEC-1 (Dam Safety Investigation), September, 1978, prepared by the Hydrologic Engineering Center, U.S. Army Corps of Engineers, Davis, California. A brief description of the methodology used in the analysis is presented below.

1. Precipitation. The Probable Maximum Precipitation (PMP) is derived and determined from regional charts prepared from past rainfall records including "Hydrometeorological Report No. 40" prepared by the U.S. Weather Bureau.

The index rainfall is reduced from 10% to 20% depending on watershed size by utilization of what is termed the HOP Brook adjustment factor. Distribution of the total rainfall is made by the computer program using distribution methods developed by the Corps.

2. Inflow Hydrograph. The hydrologic analysis used in development of the overtopping potential is based on applying a hypothetical storm to a unit hydrograph to obtain the inflow hydrograph for reservoir routing.

The unit hydrograph is developed using the Snyder method. This method requires calculation of several key parameters. The following list gives these parameters their definition and how they were obtained for these analysis.

Parameter	Definition	Where Obtained
Ct	Coefficient representing variations of watershed	From Corps of Engineers*
L	Length of main stream channel miles	From U.S.G.S. 7.5 minute topgraphic
Lca	Length on main stream to centroid of watershed	From U.S.G.S. 7.5 minute topographic
Cp	Peaking coefficient	From Corps of Engineers*
A	Watershed size	From U.S.G.S. 7.5 minute topographic

*Developed by the Corps of Engineers on a regional basis for Pennsylvania.

3. Routing. Reservoir routing is accomplished by using Modified Plus routing techniques where the flood hydrograph is routed through reservoir storage. Hydraulic capacities of the outlet works, spillways and the crest of the dam are used as outlet controls in the routing.

The hydraulic capacity of the outlet works can either be calculated and input or sufficient dimensions input and the program will calculate an elevation discharge relationship.

Storage in the pool area is defined by an area - elevation relationship from which the computer calculates storage. Surface areas are either planimetered from available mapping or U.S.G.S. 7.5 minute series topographic maps or taken from reasonably accurate design data.

4. Dam Overtopping. Using given percentages of the PMF the computer program will calculate the percentage of the PMF which can be controlled by the reservoir and spillway without the dam overtopping.

5. Dam Breach and Downstream Routing. The computer program is equipped to determine the increase in downstream flooding due to failure of the dam caused by overtopping. This is accomplished by routing both the pre-failure peak flow and the peak flow through the breach (calculated by the computer *with given input assumptions*) at a given point in time and determining the water depth in the downstream channel. Channel cross-sections taken from U.S.G.S. 7.5 minute topographic maps were used in the downstream flood wave routing. Pre and post failure water depths are calculated at locations where cross-sections are input.

HYDROLOGY AND HYDRAULICS ANALYSIS
DATA BASE

NAME OF DAM: Shickshinny Lake Dam

PROBABLE MAXIMUM PRECIPITATION (PMP) = 22.2 (0.99) = 21.98 inches

STATION	1	2	3
Station Description	Hidden Lake	Shickshinny Lake	
Drainage Area (square miles)	0.36	5.59	
Cumulative Drainage Area (square miles)	0.36	5.95	
Adjustment of PMF for Drainage Area (%)(1)			
6 hours	117	117	
12 hours	127	127	
24 hours	136	136	
48 hours	142	142	
72 hours	145	145	
Snyder Hydrograph Parameters			
Zone (2)	13	13	
Cp (3)	0.5	0.5	
Ct (3)	1.85	1.85	
L (miles) (4)	0.66	4.88	
Lca (miles) (4)	0.38	2.41	
tp = Ct(LxLca) 0.3 hrs.	1.22	3.87	
Spillway Data		Emergency	Principal
Crest Length (ft)	35	65	12
Freeboard (ft)	0.20	6.1	9.9
Discharge Coefficient	3.2	C'=0.95	Varies
Exponent	1.5	N/A	N/A

(1) Hydrometeorological Report 40 (Figure 1), U.S. Army Corps of Engineers, 1965.

(2) Hydrological zone defined by Corps of Engineers, Baltimore District, for determining Snyder's coefficients (C_p and C_t).

(3) Snyder's Coefficients.

(4) L=Length of longest water course from outlet to basin divide. L_{ca}=Length of water course from outlet to point opposite the centroid of drainage area.

CHECK LIST
HYDROLOGIC AND HYDRAULIC
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: 5.95 mi^2 wooded, moderate slopes

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 2450 ac-ft

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): 3575 ac-ft

ELEVATION MAXIMUM DESIGN POOL: Unknown

ELEVATION TOP DAM: 947.9

SPILLWAY CREST:

	Principal Spillway	Emergency spillway
a. Elevation	938.0	941.8
b. Type	Riser	Trapezoidal
c. Width	N/A	65 feet
d. Length	12 feet	N/A
e. Location Spillover	Reservoir	Right abutment
f. Number and Type of Gates	N/A	None

OUTLET WORKS:

a. Type	30" RCP
b. Location	Through embankment
c. Entrance inverts	Unknown
d. Exit inverts	915.0
e. Emergency draindown facilities	30" RCP

HYDROMETEOROLOGICAL GAUGES:

a. Type	None
b. Location	None
c. Records	None

MAXIMUM NON-DAMAGING DISCHARGE: Unknown

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DAM NAME Shickshinny Lake
I.D. NUMBER DER. NO. 40-230
SHEET NO. 1 OF 3
BY BJR DATE 6/11/80

Loss Rate and Base Flow Parameters

As recommended by the Baltimore District, Corps of Engineers.

STRTL = 1 inch

CNSTL = 0.05 in/hr

STRTQ = 1.5 cfs/mi^2

QRCSN = 0.05 (5% of Peak Flow)

RTIOR = 2.0

Elevation-Capacity Relationships

Obtained from U.S.G.S. 7.5 min Quad., DER Files, and field inspection data.

Stage-Storage Curve

Hidden Lake Dam p. D-6
Shickshinny Lake Dam p. D-7

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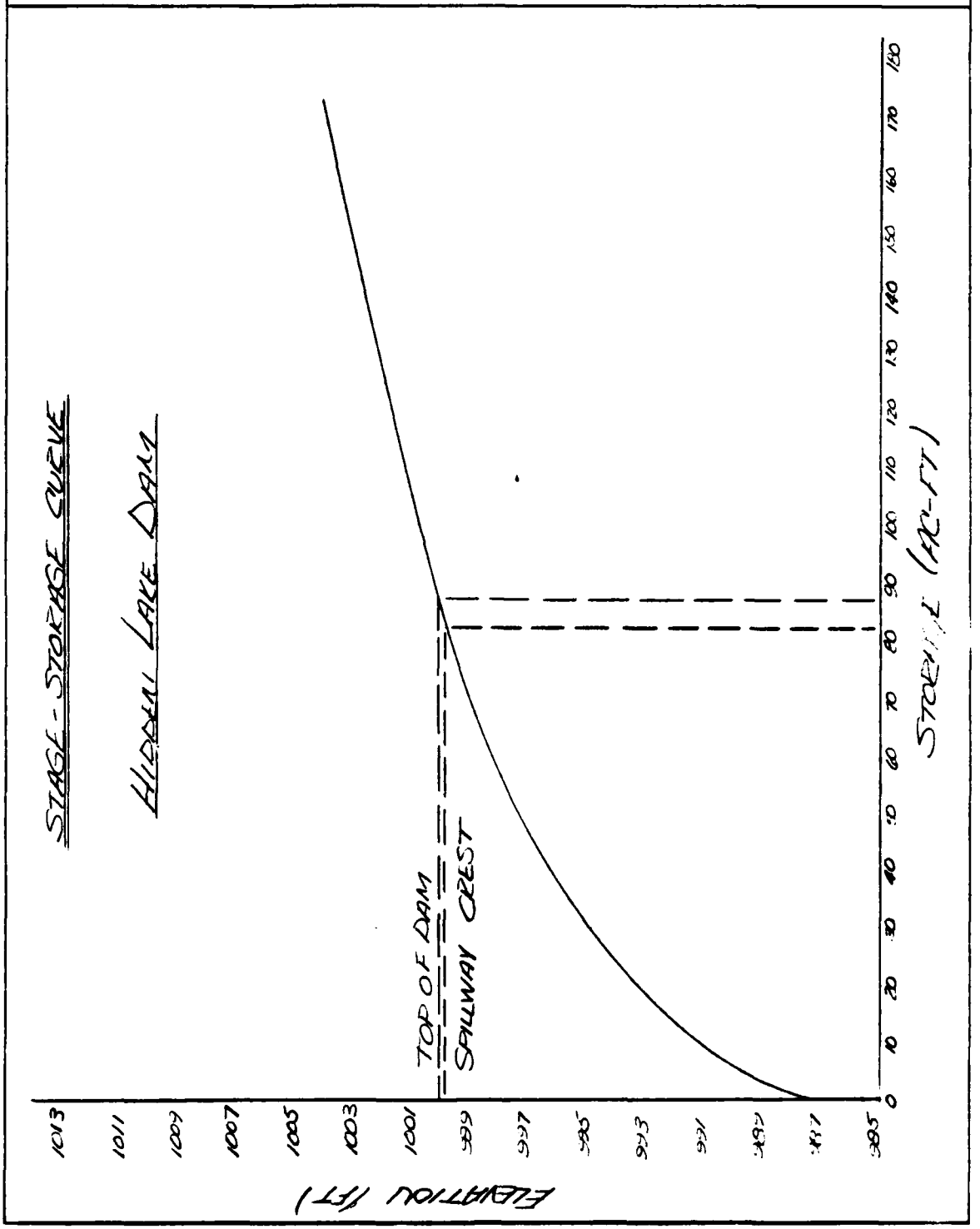
DAM NAME SHICKSHINNY LAKE
I.D. NUMBER DER. NO. 40-220
SHEET NO. 2 OF 8
BY GB DATE 6/20/88



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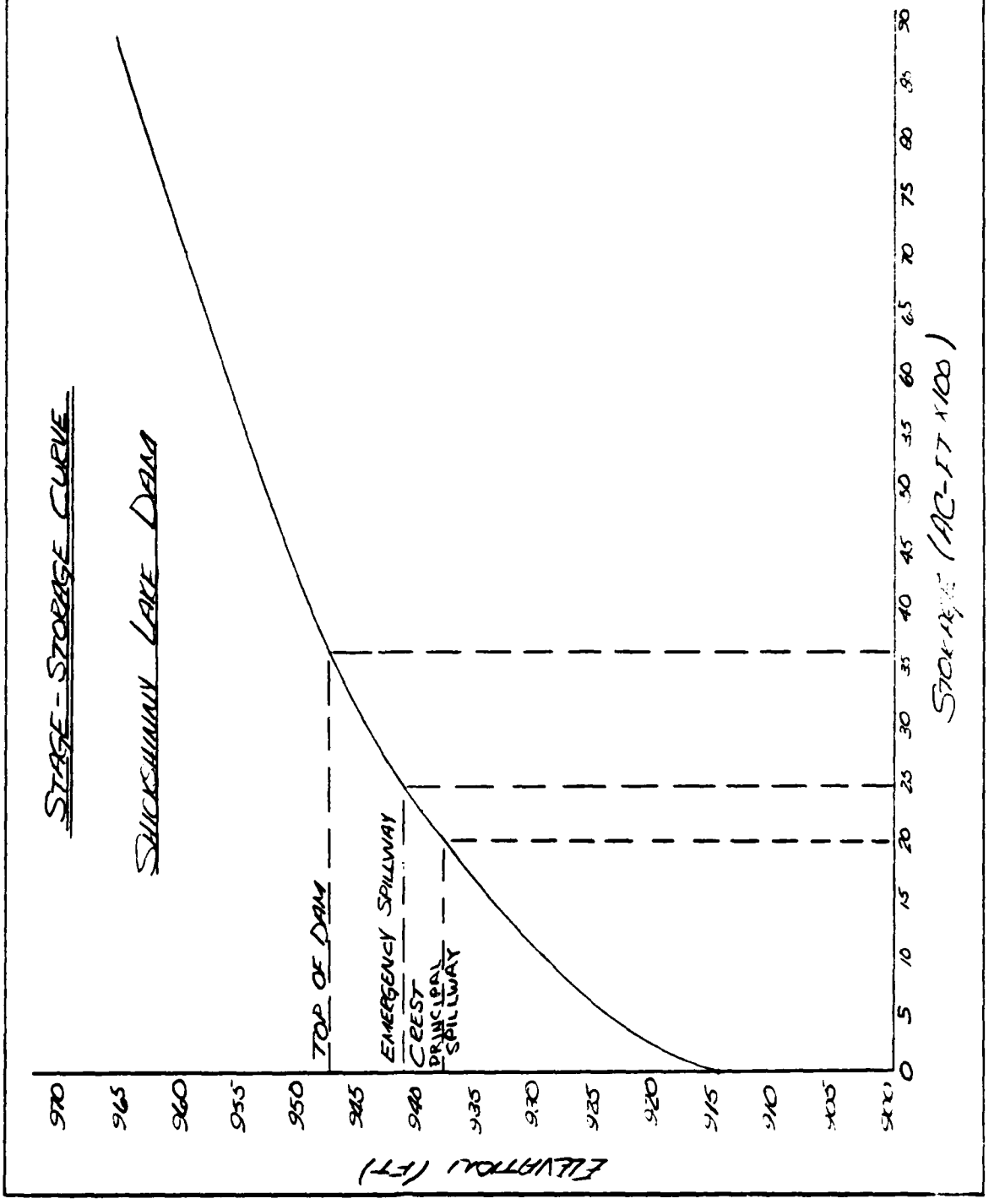
EBENSBURG PENNSYLVANIA

DAM NAME SHICKSHINNY LAKE
I.D. NUMBER DER. NO. 40-220
SHEET NO. 7 OF 8
BY EJP DATE 6/12/80



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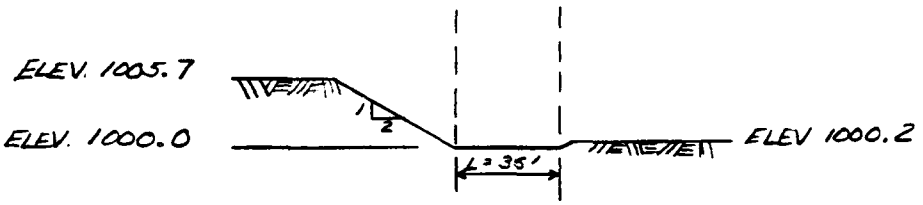
DAM NAME SHICKSHINNY LAKE
I.D. NUMBER DEP. NO. 40-220
SHEET NO. 4 OF 8
BY RJE DATE 6/12/80

DISCHARGE RATING CURVE

HIDDEN LAKE

Determined by (HEC-1).

Assume Standard Weir Flow
(U.T.S.)



Spillway Crest Elevation = 1000.0 FT
Weir Length = 35 FT
Coefficient of Discharge = 3.2

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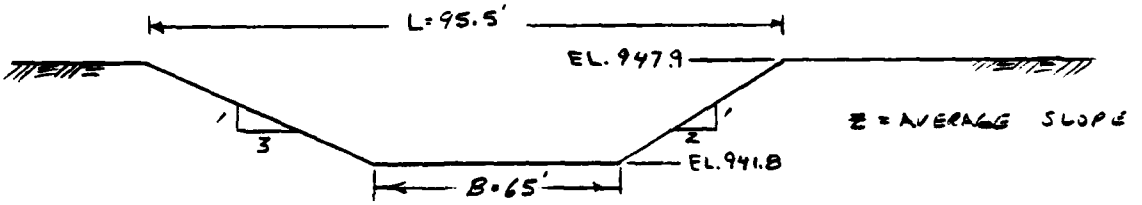
DAM NAME SHICKSHINNY LAKE
I.D. NUMBER DER. I.D. 40-220
SHEET NO. 5 OF 8
BY RJB DATE 6/12/80

SHICKSHINNY LAKE

TRAPEZOIDAL SPILLWAY
(NOT TO SCALE)



$C' = .95 \quad Z = 2.5 \quad L = 95.5 \quad C = 3.2$

	TRAPEZOIDAL		WEIR		
ELEV (FT)	h_p (FT)	Q^* (CFS)	h_p (FT)	Q^* (CFS)	Q^*_{TOTAL} (CFS)
941.8	0	0			0
942.0	.2	15			15
943.0	1.2	260			260
944.0	2.2	660			660
945.0	3.2	1185			1185
946.0	4.2	1820			1820
947.0	5.2	2570			2570
947.9	6.1	3335	0	0	3335
949.0			1.1	350	3685
950.0			2.1	930	4265
952.5			4.6	3015	6350
955.0			7.1	5780	9115

* Values rounded to nearest 5 cfs

From: $Q = 8.03 C' h_v^{1/2} (h_p - h_v)[B + Z(h_p - h_v)]$

where $h_v = \dfrac{3(2Z h_p + B) - (16Z^2 h_p^2 + 16Z B h_p + 9B^2)^{1/2}}{10Z}$

Source: Water and Wastewater Engineering by Fair, Geyer & Okum 1966 p. (11-14) & (11-15)

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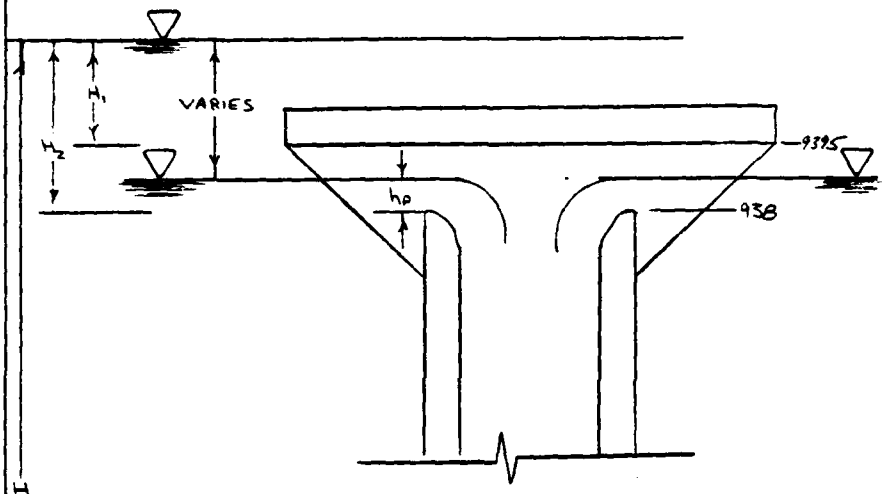
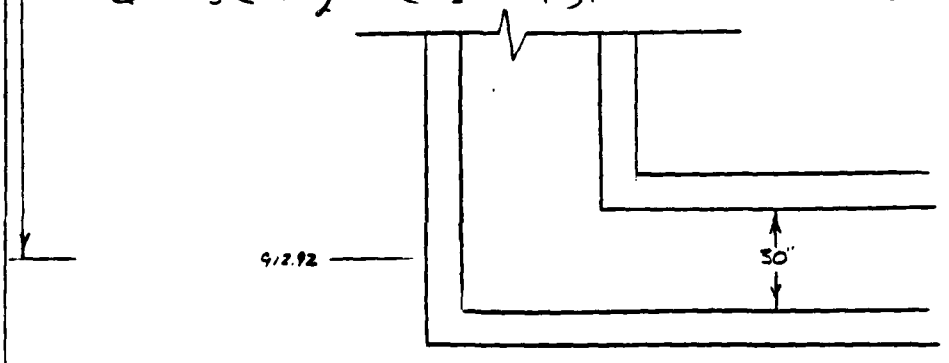
EBENSBURG PENNSYLVANIA

NAME SHICKSHINNY LAKE
NUMBER 40-220
SHEET NO. 6 OF 8
BY CAB DATE 7-18-80

PRINCIPAL SPILLWAY RATING CURVE



FOR WATER LEVELS BELOW 939.5 FLOW IS GOVERNED BY CREST CONTROL WHERE THE INLET ACTS LIKE A WEIR AND $Q = CLh_p^{1.5}$. FOR WATER LEVELS ABOVE 939.5 FLOW IS GOVERNED BY ORIFICE FLOW WHERE $Q = \frac{2}{3} C' \sqrt{2g}\, L (H_2^{3/2} - H_1^{3/2})$. $C = 3.3$ $C' = .6$ $L = 12'$



FOR FULL PIPE FLOW DISCHARGE IS GOVERNED BY $Q = A\sqrt{\frac{2gH}{1 + K_E + K_b + K_p L}}$, WHERE K VALUES ARE LOSS COEFFICIENTS, WHERE $K_E = .5$ $K_b = .45$ $K_p = .01$ $L = 135'$ $A = 4.91^{a'}$

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EBENSBURG PENNSYLVANIA

NAME SHICKSHINNY LAKE
NUMBER 40-220
SHEET NO. 7 OF 8
BY CAR DATE 7-18-80

SOURCE: HANDBOOK OF APPLIED HYDROLOGY, BY; CHOW

HANDBOOK OF APPLIED HYDRAULICS
BY; DAVIS, SORENSEN

	WEIR		ORIFICE			FULL PIPE	
ELEV (FT)	h_p (FT)	Q* (CFS)	H_1 (FT)	H_2 (FT)	Q* (CFS)	H (FT)	Q (CFS)
938	0	0					
939	1	40					
939.5	1.5	70					
940			.5	2	95	27.08	112
941			1.5	3	~~130~~	28.08	114
942			2.5	4	~~155~~	29.08	117
943			3.5	5	~~180~~	30.08	119
945						32.08	123
948						35.08	128
950						37.08	132
952						39.08	135
955						42.08	141

*VALUES ROUNDED TO NEAREST 5CFS

Y4	938	939	939.5	940	941	942
Y5	0	40	70	95	114	132

943	945	948	950	955
379	1308	3473	4397	9256

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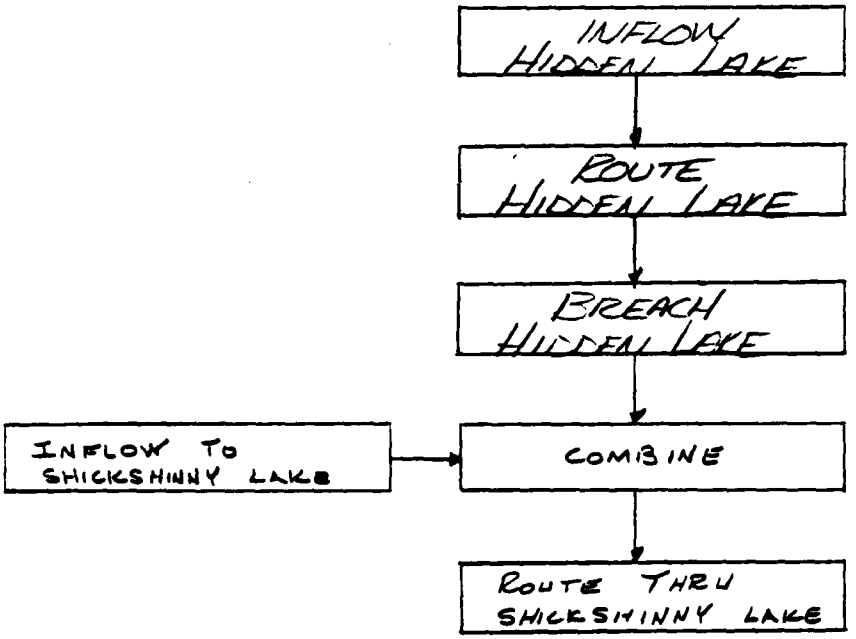
EBENSBURG PENNSYLVANIA

DAM NAME SHICKSHINNY LAKE
I.D. NUMBER DER. NO. 40-220
SHEET NO. 8 OF 8
BY AJR DATE 6/12/80

OVERTOP PARAMETERS

Top of Dam Elevation (low Spot) = 947.9 FT
Length of Dam (Excluding Spillway) = 365 FT
Coefficient of Discharge = 3.1
#Lmax = 398 FT
#Vmax = 950.8 FT

PROGRAM SCHEDULE



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**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION     JULY 1978
  LAST MODIFICATION  26 FEB 79
**********
     1          A1     ANALYSIS OF DAM OVERTOPPING USING RATIOS OF PMF
     2          A2     HYDROLOGIC-HYDRAULIC ANALYSIS OF SAFETY OF SHICKSHINNY LAKE DAM - PA 872
     3          A3     RATIOS OF PMF ROUTED THROUGH THE RESERVOIR
     4          B   288       0      15       0       0       0       0       0       0       0
     5          B1    5
     6          J     1       4       1
     7          J1  .3      .5      .7      1
     8          K     0       1                               1
     9          K1     INFLOW TO HIDDEN LAKE
    10          M     1       1     .36                                       1
    11          P           21.98     117     127     136     142     145
    12          T                                             1.0    0.05
    13          W   1.22    0.50
    14          X   -1.5    -.09     2.0
    15          K     1       2                               1
    16          K1     ROUTE THROUGH HIDDEN LAKE
    17          Y                             1       1
    18          Y1    1                                     -1000.0
    19          SS    0     0.2     2.0     6.5    17.2    32.1    51.2    76.4    82.2    87.0
    20          SS  124.0   169.0   218.0   273.0   334.0
    21          SE  985.6   987.6   989.6   991.6   993.6   995.6   997.6   999.6  1000.0  1000.2
    22          SE1002.0  1004.0  1006.0  1008.0  1010.0
    23          SS1000.0    35.0     3.2     1.5
    24          SD1000.2     3.1     1.5   500.0
    25          SL   10.0   177.0   485.0   513.0   532.0   549.0   562.0
    26          SV1000.2  1001.0  1002.0  1003.0  1004.0  1005.0  1005.7
    27          SB   20     0.5   980.2       1    1000  1000.4
    28          K     1       3                               1
    29          K1     CHANNEL ROUTING
    30          Y                             1       1
    31          Y1    1
    32          Y6  0.06    0.05    0.06     938     960    1450   0.028
    33          Y7    0     960      50     950     100     940     102.    938     107     938
    34          Y7  109     940     150     950     200     960
    35          K     0       3                               1
    36          K1     INFLOW TO SHICKSHINNY LAKE
    37          M     1       1    9.59                                       1
    38          P           21.98     117     127     136     142     145
    39          T                                             1.0    0.05
    40          W   3.87    0.5
    41          X   -1.5    -.05     2.0
    42          K     2       4                               1
    43          K1     COMBINE
    44          K     1       5                               1
    45          K1     ROUTE THRU SHICKSHINNY LAKE
```

```
46        Y                                   1          1
47        Y1     1                                                  -941.8       -1
48        Y4   938      939    939.5     940        941        942     943        945       948       950
49        Y4   955
50        Y5     0       40       70      95        114        132     379       1308      3473      4397
51        Y6  9256
52        $$     0     1950     2450    3575       4050       7025
53        $E   915      938    941.8   947.9        950        960
54        $$ 941.8
55        $D 947.9      3.1      1.5     365
56        $L    20      120      340     371        398
57        $V 947.9      948      949   949.3      950.8
58        K     99
```

D-14

```
**************************************
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION        JULY 1978
  LAST MODIFICATION   26 FEB 79
**************************************

RUN  DATE* 80/07/17.
     TIME* 13.08.18.

                     ANALYSIS OF DAM OVERTOPPING USING RATIOS OF PMF
                     HYDROLOGIC-HYDRAULIC ANALYSIS OF SAFETY OF SHICKSHINNY LAKE DAM - PA 572
                     RATIOS OF PMF ROUTED THROUGH THE RESERVOIR

                                         JOB SPECIFICATION
               NQ      NHR     NMIN     IDAY      IHR     IMIN    METRC     IPLT     IPRT    NSTAN
              288        0       15        0        0        0        0        0        0        0
                                       JOPER      NWT    LROPT    TRACE
                                           5        0        0        0

                                    MULTI-PLAN ANALYSES TO BE PERFORMED
                                      NPLAN= 1 NRTIO= 4 LRTIO= 1
                    RTIOS=    .30     .50     .70    1.00
```

********** ********** ********** ********** **********

SUB-AREA RUNOFF COMPUTATION

INFLOW TO HIDDEN LAKE

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
1	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	.36	0.00	.36	0.00	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	21.98	117.00	127.00	136.00	142.00	145.00	0.00

TRSPC COMPUTED BY THE PROGRAM IS .800

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.05	0.00	0.00

D-15

UNIT HYDROGRAPH DATA

TP= 1.22 CP= .50 NTA= 0

RECESSION DATA

STRTQ= -1.50 QRCSN= -.05 RTIOR= 2.00

APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SNYDER CP AND TP ARE TC= 5.35 AND R= 6.49 INTERVALS

UNIT HYDROGRAPH 38 END-OF-PERIOD ORDINATES, LAG= 1.23 HOURS, CP= .50 VOL= 1.00

8.	28.	55.	81.	95.	93.	81.	70.	60.	51.
44.	38.	32.	28.	24.	20.	17.	15.	13.	11.
9.	8.	7.	6.	5.	4.	4.	3.	3.	2.
2.	2.	1.	1.	1.	1.	1.	1.		

********** ********** ********** ********** **********

HYDROGRAPH ROUTING

ROUTE THROUGH HIDDEN LAKE

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
2	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-1000.	0

CAPACITY=	0.	0.	2.	7.	17.	32.	51.	76.	82.	87.
	124.	169.	218.	273.	334.					
ELEVATION=	986.	988.	990.	992.	994.	996.	998.	1000.	1000.	1000.
	1002.	1004.	1006.	1008.	1010.					

D-1

CREL	SPWID	COOW	EXPW	ELEVL	COOL	CAREA	EXPL
1000.0	35.0	3.2	1.5	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COOD	EXPD	DAMWID
1000.2	3.1	1.5	500.

CREST LENGTH AT OR BELOW	10.	177.	485.	513.	532.	549.	562.

ELEVATION	1000.2	1001.0	1002.0	1003.0	1004.0	1005.0	1005.7

DAM BREACH DATA

BRWID	Z	ELBM	TFAIL	WSEL	FAILEL
20.	.50	980.20	1.00	1000.00	1000.40

OVN

********** ********** ********** ********** **********

HYDROGRAPH ROUTING

CHANNEL ROUTING

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
3	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	L&TR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	0.	0

NORMAL DEPTH CHANNEL ROUTING

	QN(1)	QN(2)	QN(3)	ELNVT	ELMAX	RLNTH	SEL
	.0600	.0500	.0600	938.0	960.0	1450.	.02800

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC

0.00 960.00 50.00 950.00 100.00 940.00 102.00 938.00 107.00 938.00
109.00 940.00 150.00 950.00 200.00 960.00

STORAGE	0.00	.24	.58	1.24	2.30	3.78	5.66	7.94	10.63
...13.73	17.23	21.15	25.51	30.32	35.57	41.27	47.42	54.01	61.05
...68.54									
OUTFLOW	0.00	32.19	114.49	287.26	590.91	1064.38	1741.57	2653.43	3828.81
..5294.98	7077.97	9179.94	11645.04	14514.47	17813.78	21567.81	25800.78	30536.30	35797.48
.41606.89									
STAGE	938.00	939.16	940.32	941.47	942.63	943.79	944.95	946.11	947.26
...948.42	949.58	950.74	951.89	953.05	954.21	955.37	956.53	957.68	958.84
...960.00									
FLOW	0.00	32.19	114.49	287.26	590.91	1064.38	1741.57	2653.43	3828.81
.45294.98	7077.97	9179.94	11645.04	14514.47	17813.78	21567.81	25800.78	30536.30	35797.48
.41606.89									

********** ********** ********** ********** **********

SUB-AREA RUNOFF COMPUTATION

INFLOW TO SHICKSHINNY LAKE

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
3	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	5.59	0.00	5.59	0.00	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	21.98	I17.00	I27.00	I36.00	I42.00	I45.00	0.00

TRSPC COMPUTED BY THE PROGRAM IS .800

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.05	0.00	0.00

UNIT HYDROGRAPH DATA

TP= 3.87 CP= .50 NTA= 0

RECESSION DATA

STRTQ= -1.50 QRCSN= -.05 RTIOR= 2.00

APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SNYDER CP AND TP ARE TC=16.43 AND R=21.04 INTERVALS

UNIT HYDROGRAPH 100 END-OF-PERIOD ORDINATES, LAG= 3.90 HOURS, CP= .50 VOL= .99

7.	27.	55.	90.	128.	170.	214.	260.	308.	351.
389.	421.	446.	464.	476.	479.	469.	449.	428.	408.
389.	371.	354.	337.	322.	307.	293.	279.	266.	254.
242.	231.	220.	210.	200.	191.	182.	173.	165.	158.
150.	143.	137.	130.	124.	119.	113.	108.	103.	98.
94.	89.	85.	81.	77.	74.	70.	67.	64.	61.
58.	55.	53.	50.	48.	46.	44.	42.	40.	38.
36.	34.	33.	31.	30.	28.	27.	26.	25.	24.
22.	21.	20.	19.	19.	18.	17.	16.	15.	15.
14.	13.	13.	12.	12.	11.	11.	10.	10.	9.

0

7/10

********** ********** ********** ********** **********

COMBINE HYDROGRAPHS

COMBINE

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
4	2	0	0	0	0	1	0	0

********** ********** ********** ********** **********

HYDROGRAPH ROUTING

ROUTE THRU SHICKSHINNY LAKE

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
5	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-942.	-1

STAGE	938.00	939.00	939.50	940.00	941.00	942.00	943.00	945.00	948.00	...950.00	955.00
FLOW	0.00	40.00	70.00	95.00	114.00	132.00	379.00	1308.00	3473.00	..4397.00	9256.00

CAPACITY=	0.	1950.	2450.	3575.	4050.	7025.
ELEVATION=	915.	938.	942.	948.	950.	960.

CREL	SPWID	COQW	EXPW	ELEVL	COQL	CAREA	EXPL
941.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID
947.9	3.1	1.5	365.

CREST LENGTH	20.	120.	340.	371.	398.

AT OR BELOW ELEVATION	947.9	948.0	949.0	949.[illegible]	950.8

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS RATIO 1 .30	RATIO 2 .50	RATIO 3 .70	RATIO 4 1.00
HYDROGRAPH AT	1	.36	1	316.	527.	738.	1054.
		(.93)		(8.95)	(14.92)	(20.89)	(29.84)
ROUTED TO	2	.36	1	2072.	2092.	2083.	1992.
		(.93)		(58.66)	(59.25)	(58.99)	(56.41)
ROUTED TO	3	.36	1	2064.	2082.	2073.	1988.
		(.93)		(58.45)	(58.97)	(58.69)	(56.30)
HYDROGRAPH AT	3	5.59	1	2497.	4161.	5826.	8322.
		(14.48)		(70.70)	(117.83)	(164.97)	(235.67)
2 COMBINED	4	5.95	1	2925.	4595.	6563.	9178.
		(15.41)		(82.81)	(130.12)	(185.84)	(259.90)
ROUTED TO	5	5.95	1	1959.	3337.	4983.	7874.
		(15.41)		(55.47)	(94.49)	(141.10)	(222.98)

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 ..... INITIAL VALUE SPILLWAY CREST TOP OF DAM

ELEVATION	1000.00	1000.00	1000.20
STORAGE	82.	82.	87.
OUTFLOW	0.	0.	10.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.30	1000.42	.22	91.	2099.	2.23	38.71	38.00
.50	1000.41	.21	91.	2119.	4.23	37.96	37.25
.70	1000.42	.22	92.	2108.	4.73	37.46	36.75
1.00	1000.40	.20	91.	2027.	2.71	34.69	34.00

PLAN 1 STATION 3

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.30	2064.	945.4	38.75
.50	2082.	945.4	38.00
.70	2073.	945.4	37.50
1.00	1988.	945.3	34.75

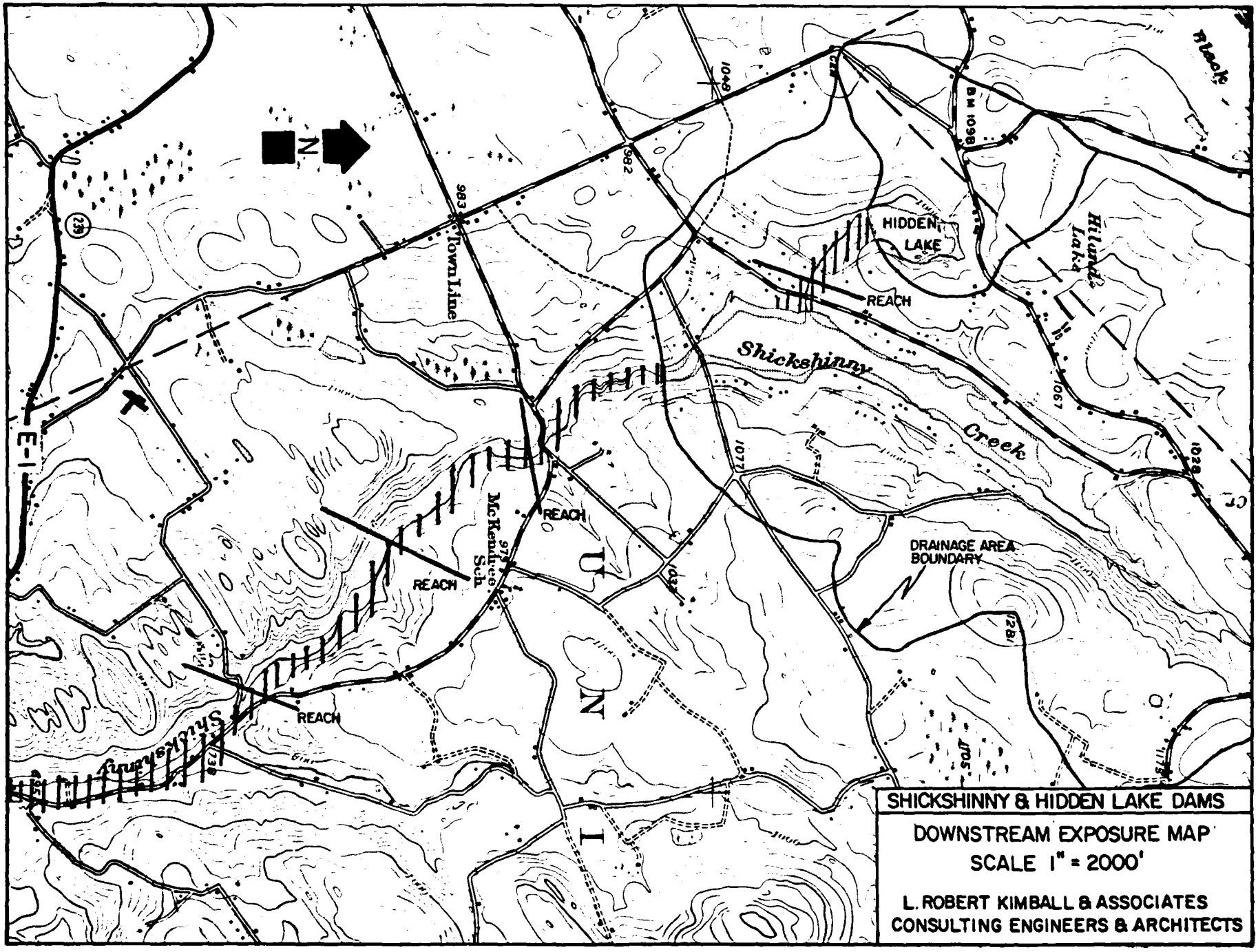
SUMMARY OF DAM SAFETY ANALYSIS

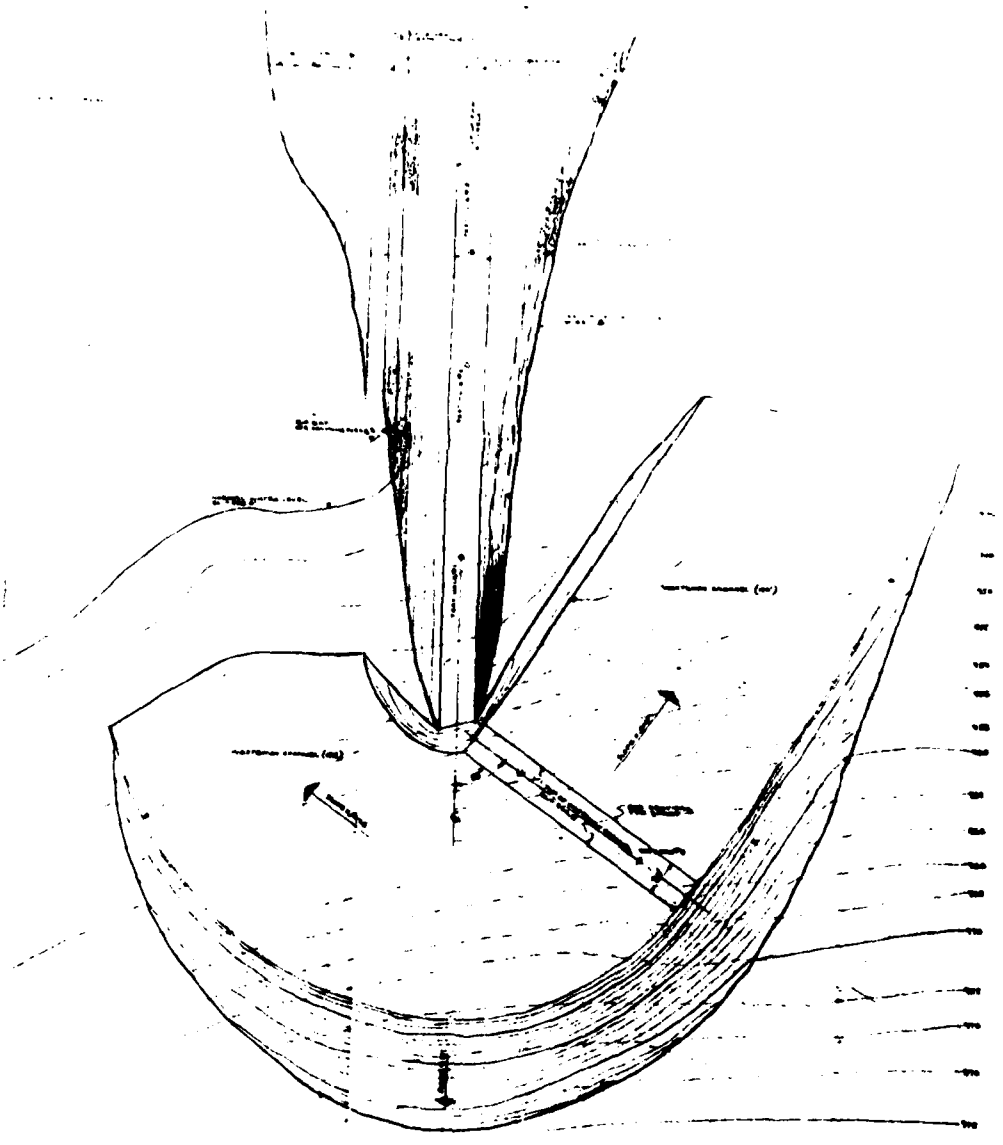
PLAN 1 ••••••••••••••••

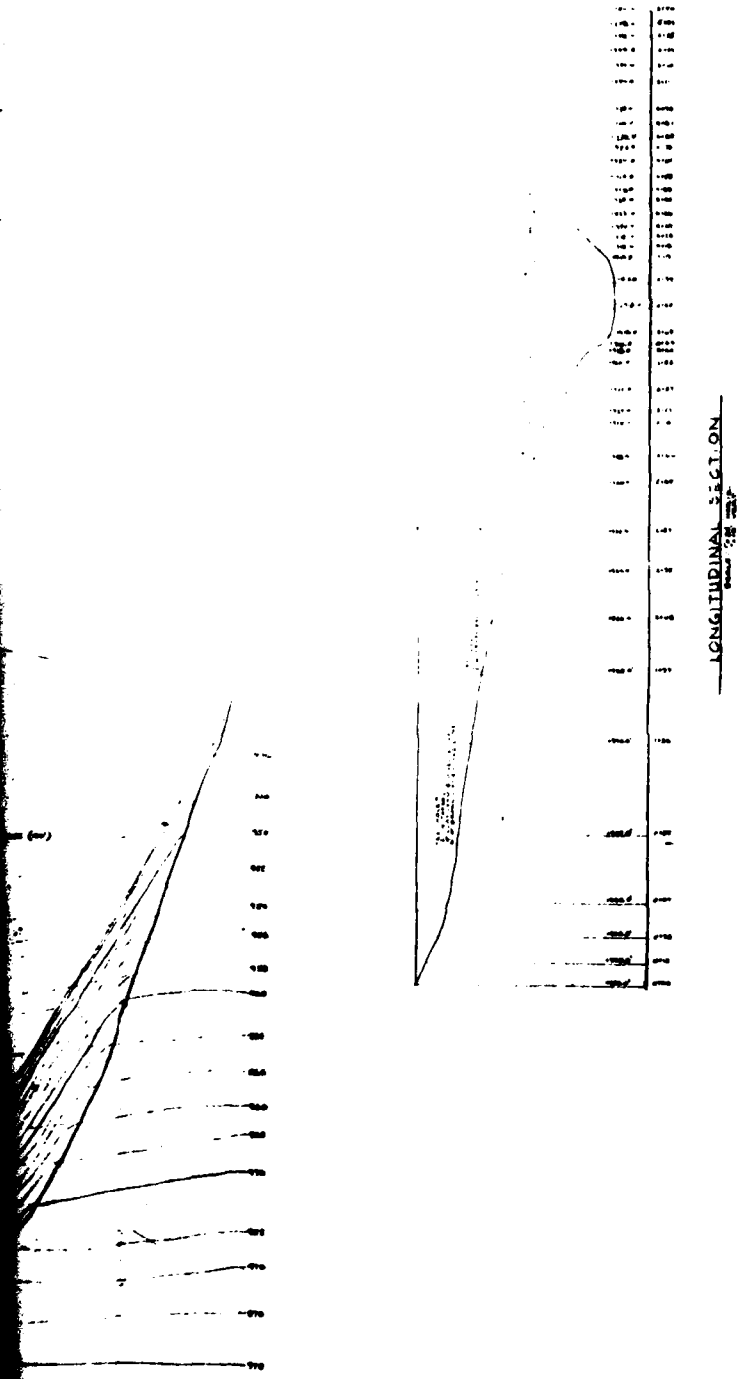
	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	941.80	941.80	947.90
STORAGE	2450.	2450.	3575.
OUTFLOW	128.	128.	3401.

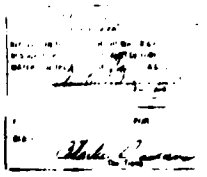
RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.30	945.90	0.00	3207.	1959.	0.00	47.00	0.00
.50	947.81	0.00	3559.	3337.	0.00	46.25	0.00
.70	949.22	1.32	3873.	4983.	7.50	45.75	0.00
1.00	950.32	2.42	4145.	7874.	10.75	44.75	0.00

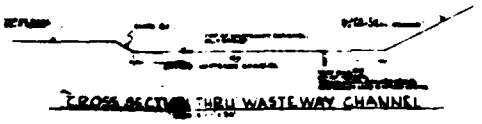
APPENDIX E
DRAWINGS

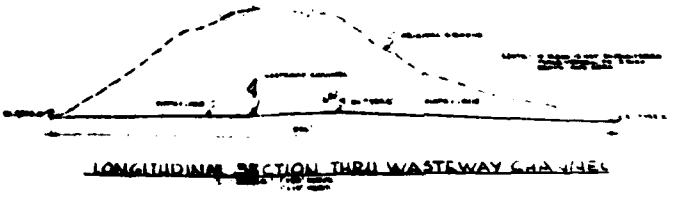

N
HIDDEN LAKE
REACH
Shickshinny
Creek
Hillard's Lake
Town Line
McKendree Sch
REACH
REACH
REACH
DRAINAGE AREA BOUNDARY
E-1
SHICKSHINNY & HIDDEN LAKE DAMS
DOWNSTREAM EXPOSURE MAP
SCALE 1" = 2000'
L. ROBERT KIMBALL & ASSOCIATES
CONSULTING ENGINEERS & ARCHITECTS

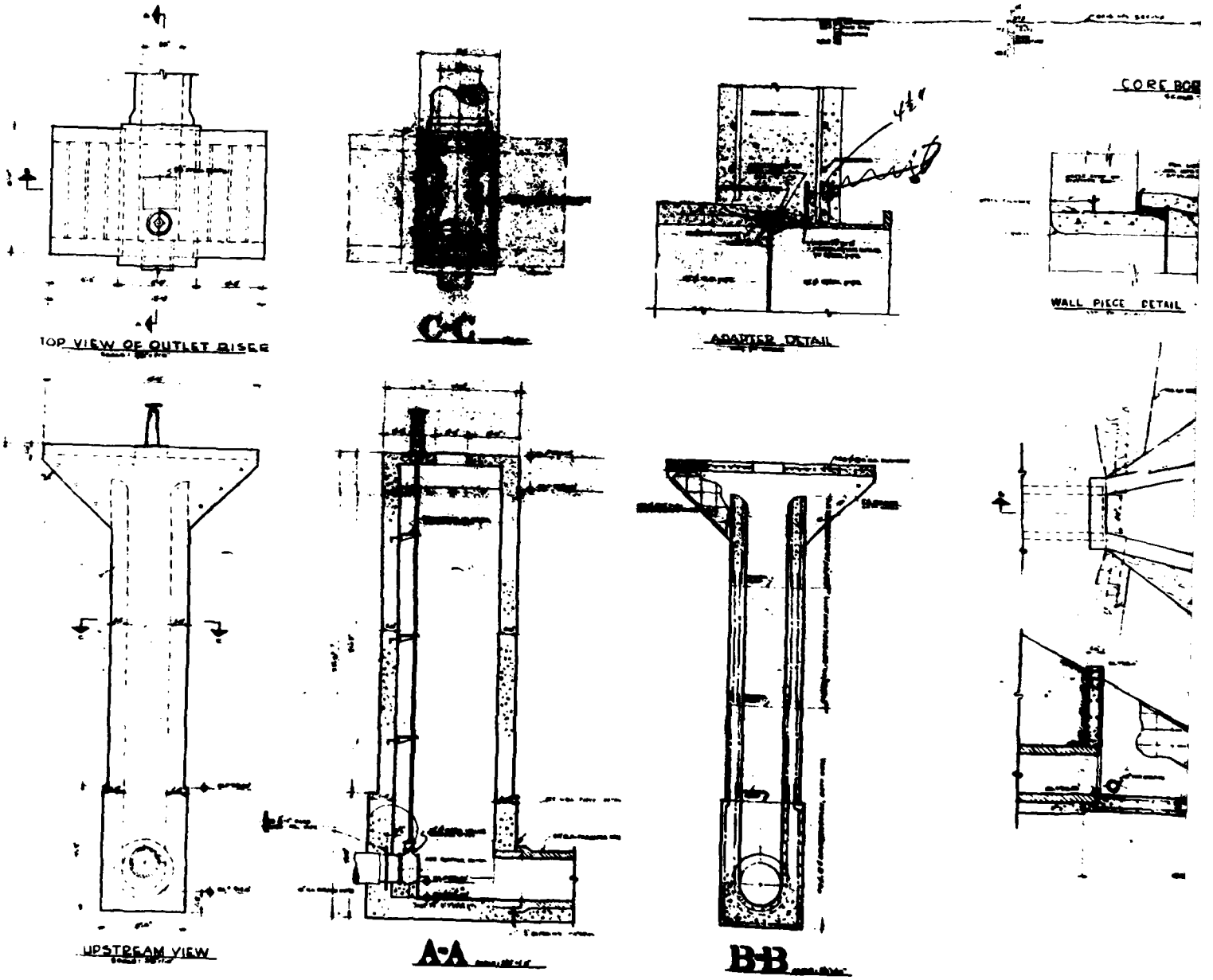


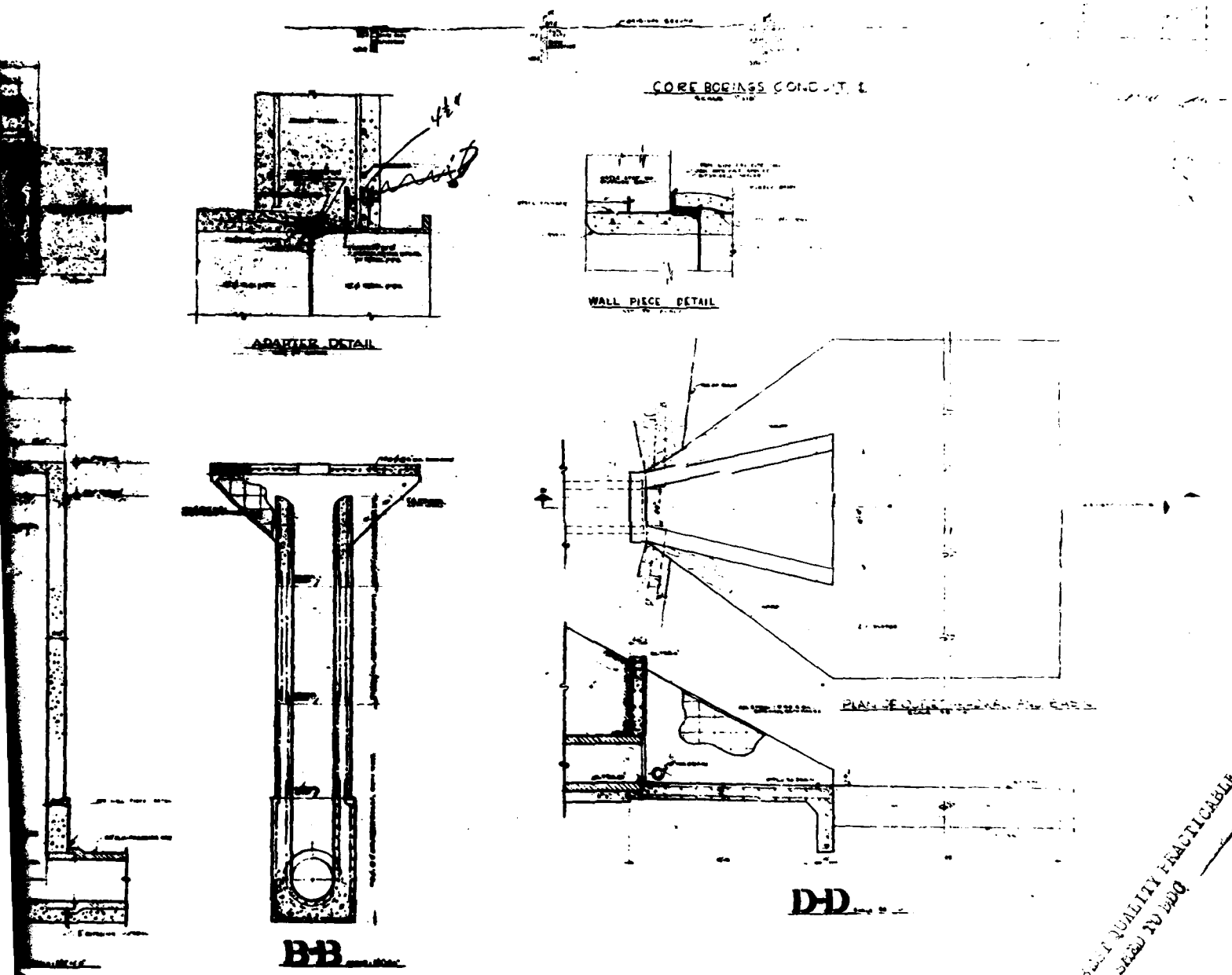


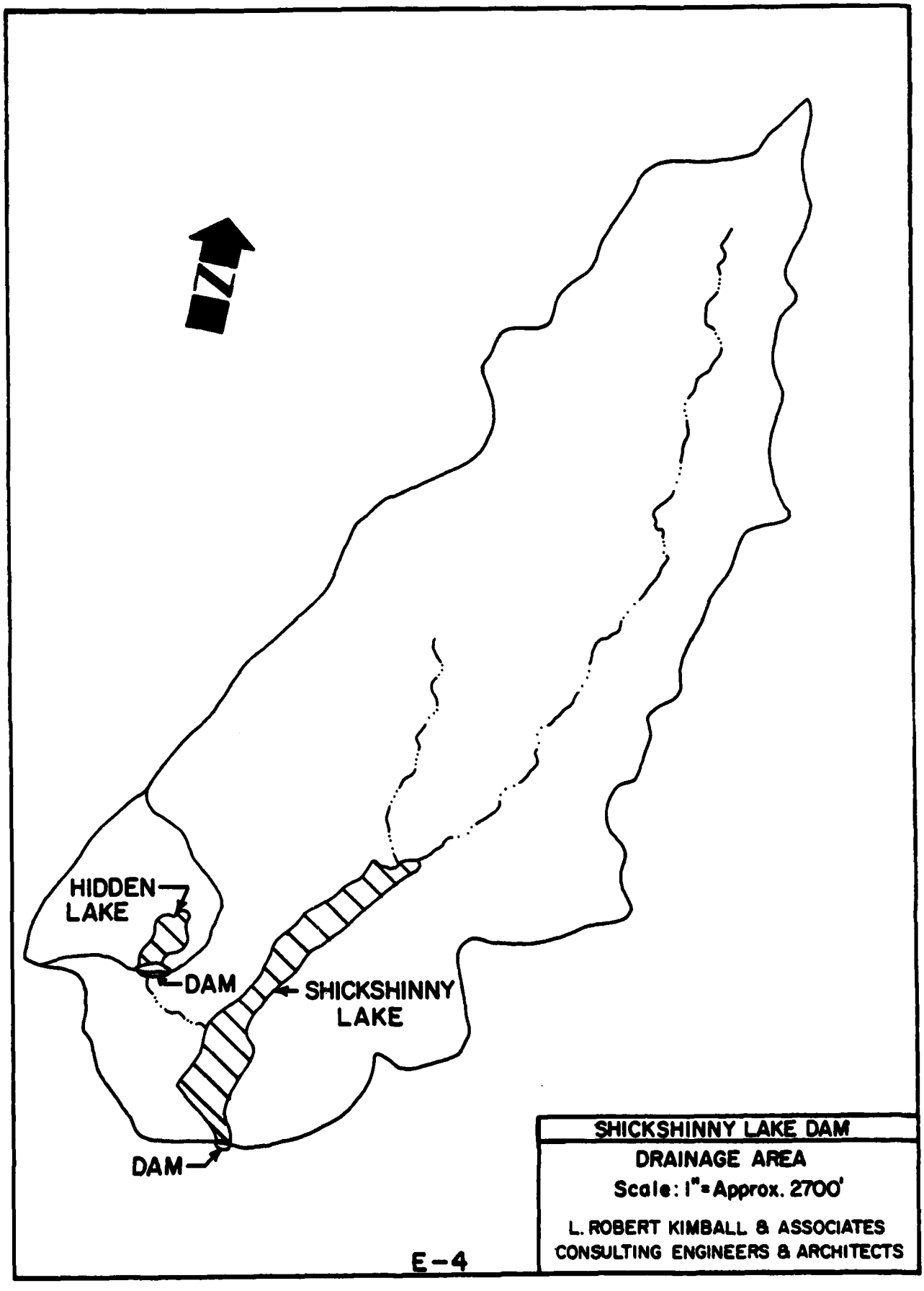










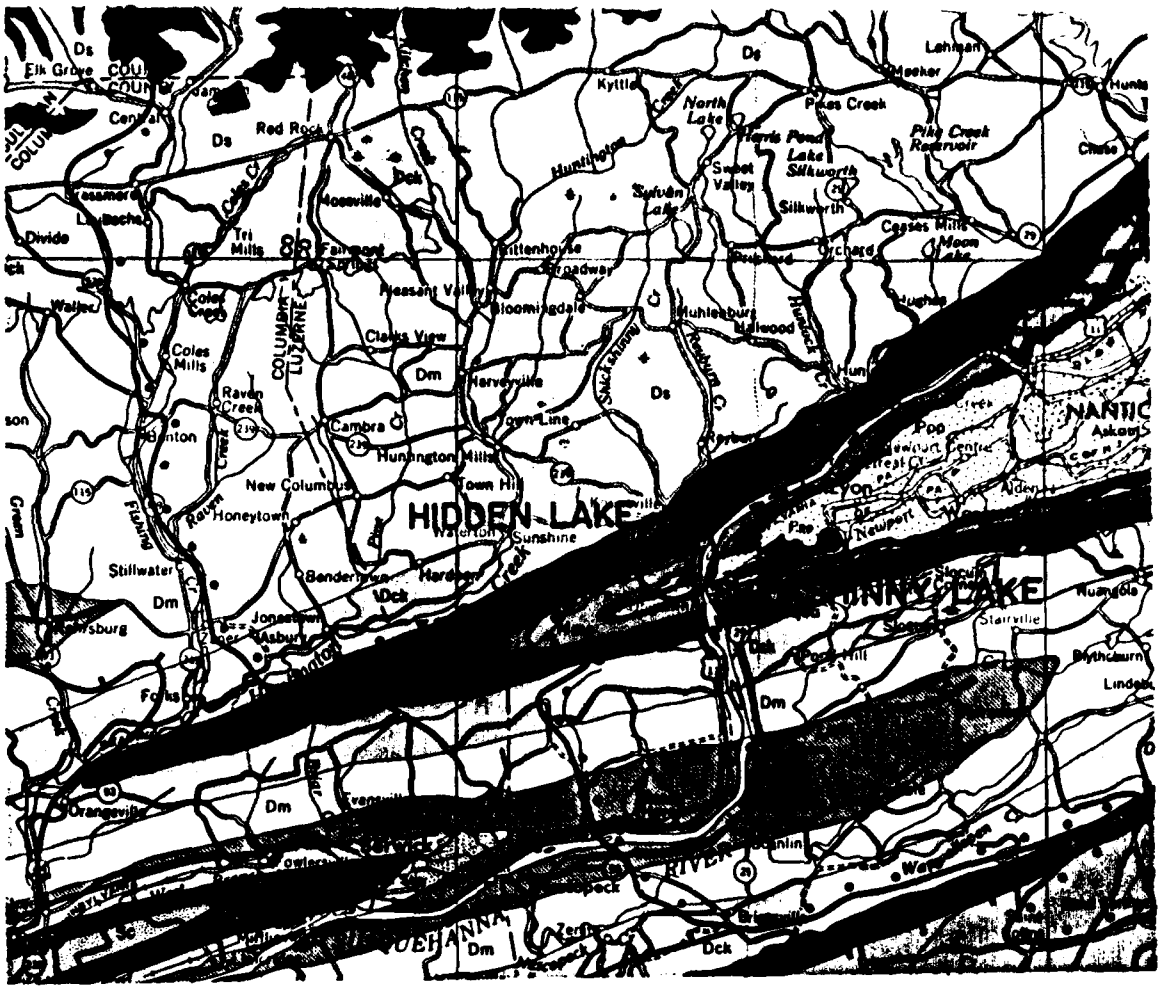

HIDDEN LAKE
DAM
SHICKSHINNY LAKE
DAM
SHICKSHINNY LAKE DAM
DRAINAGE AREA
Scale: 1" = Approx. 2700'
L. ROBERT KIMBALL & ASSOCIATES
CONSULTING ENGINEERS & ARCHITECTS

APPENDIX F
GEOLOGY

General Geology

Shickshinny Lake Dam lie within the Appalachian Mountain Section of the Valley and Ridge Physiographic Province. This region is characterized by overturned and assymetric folds, local shearing and large, low-angle thrust faults. The only faulting indicated in the area of the reservoir is about seven or eight miles away, both to the east and to the southwest.

The bedrock underlying the lake and dam is the Mississippian aged Pocono Group. This group consists mainly of sandstone with lesser amounts of conglomerate, siltstone, shale and coal. The moderate to thick bedding is normally well developed. The regular and steeply dipping to vertical joints are also well developed. The rocks of the Pocono Group are very resistant to weathering and form an excellent foundation for heavy structures. The interstitial and secondary porosity give the rocks of this group a high effective porosity.



Geologic Map of The Area Around Hidden Lake And Shickshinny Lake

Pocono Group

Predominantly gray, hard, massive, cross-bedded conglomerate and sandstone with some shale, includes in the Appalachian Plateau Burgoon, Shenango, Cuyahoga, Cussewago, Corry, and Knapp Formations, includes part of "Oswayo" of M. L. Fuller in Potter and Tioga counties.

Scale : 1:250,000